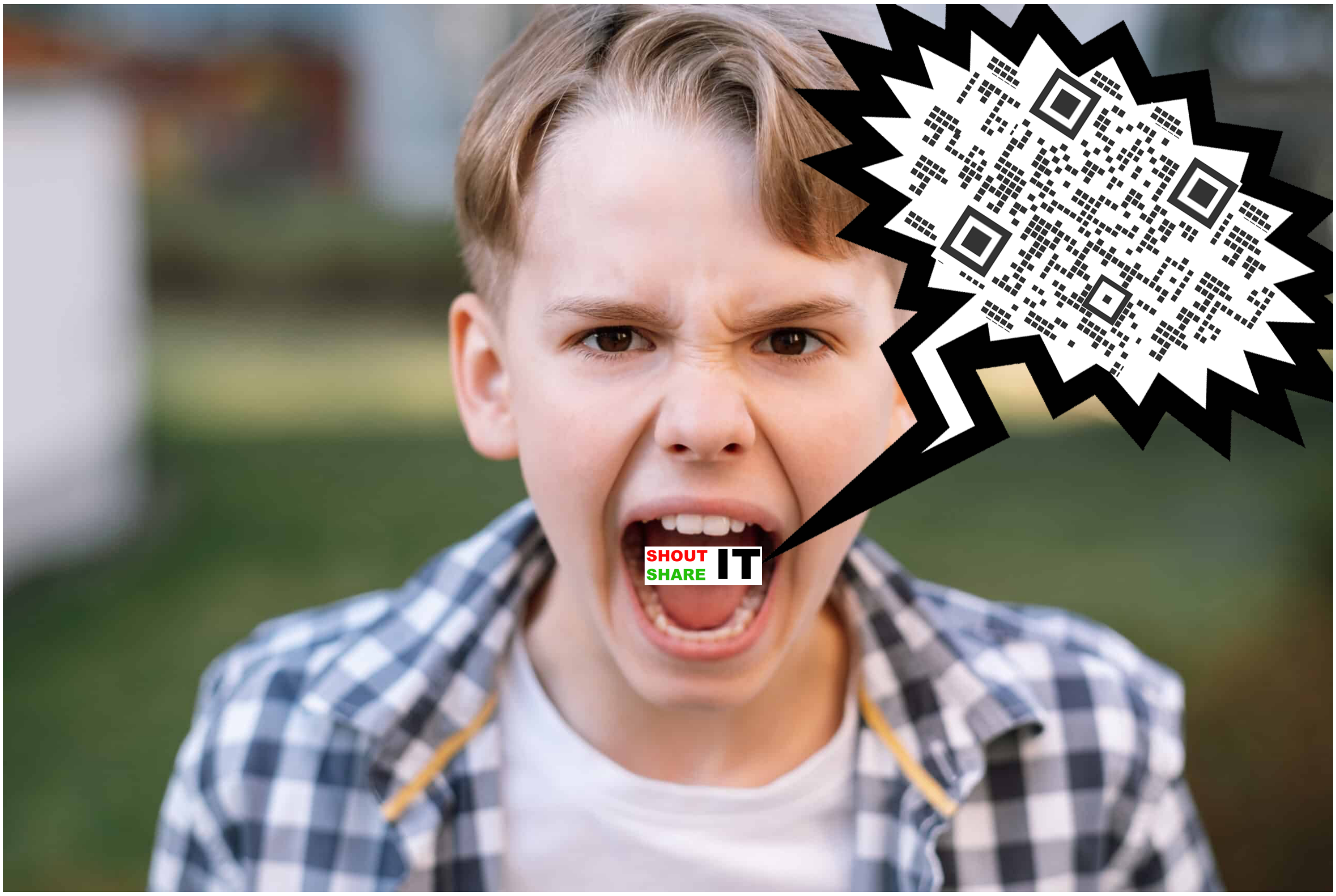
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ERRATA

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Page ii. line 14 for *viarmicus* read *biarmicus*.
,, ,, ,, 13 ,, *pencillata* read *penicillata*.
,, 55 ,, 23 ,, *Corturnex* read *Coturnix*.
,, 60 ,, 5 from bottom for *auritra* read *aurita*.
,, 68 ,, 1 *for* **Herætus** *read* **Hieraëtus.**
,, 70 ,, 9 from bottom for *breripes* read *brevipes*.
,, 87 ,, 8 *for* **Geochelidon** *read* **Gelochelidon.**
,, 114 ,, 19 ,, *Rana formosa* read *Ranae Formosae*.
,, 115 ,, 7 ,, *Rana formosa* read *Ranae Formosae*.
,, 118 ,, 2 ,, fly *read* dragonfly.
,, 121 ,, 3 ,, *Simullidae* read *Simuliidae*.
,, 137 ,, 37 ,, **garulla** *read* **garrula.**
,, 149 ,, 9 from bottom *for* **Lymnocriptes** *read* **Lymnocryptes.**
,, 217 ,, 35 for *viarmicus* read *biarmicus*.
,, 218 ,, 11 ,, *viarmicus* read *biarmicus*.
,, 218 ,, 21 ,, *pencillata* read *penicillata*.
,, 227 Last two lines should follow line 34 on page 226, i.e. they should read between '. . . forms of food offered.' and 'The inhabitant was large . . .'
,, 272 line 17 *for* Popular *read* Poplar.
,, 280 ,, 9 ,, 1829 *read* 1929.
,, 307 ,, 8 ,, Ball-throated *read* Bare-throated.
,, 323 ,, 3 from bottom *for* **rufotriata** *read* **rufostriata.**
,, 346 ,, 34 for *subuluta* read *subulata*.

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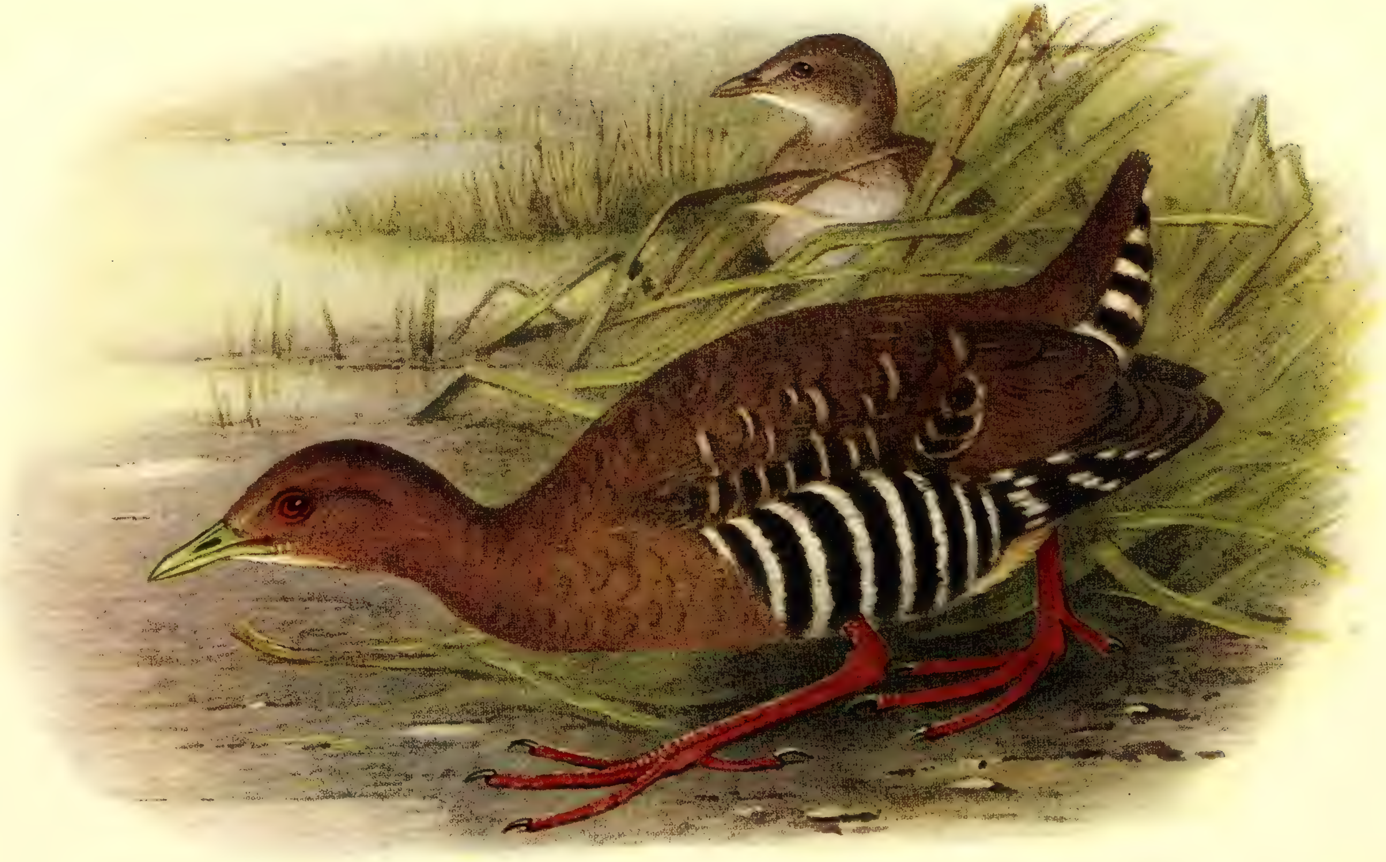

THE MALAYAN BANDED CRAKE

Rallina fasciata

$\frac{2}{3}$ life size

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THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

Vol. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

Part III

(With a coloured plate)

(Continued from page 546 of Vol. XXXI)

Amaurornis fuscus

The Ruddy Crake

There are four forms of this little Crake found within the Indian Empire, viz.:

(1) *Amaurornis fuscus fuscus.* The Ruddy Crake.

Rallus fuscus Linn., Syst. Nat., 12th ed., I., p. 262, 1766, Philippines.

This and the Ceylon form are the smallest of the four forms, with a wing between 89 and 99 mm.; the colour the same as in *P. f. bakeri* but deeper both above and below. It is found from the Philippines through Celebes, Java, Sumatra and Borneo, etc., all through the Malay Peninsula to Tenasserim.

(2) *Amaurornis fuscus bakeri.* The Northern Ruddy Crake.

Porzana fusca bakeri Hartert; Nov. Zool., 1917, p. 262 Kumaon.

Larger than the preceding bird with a wing of 97 to 110 mm. Similar in colour. Inhabiting Northern India from the

Afghan Frontier (Whitehead) and Kashmir to Eastern Assam and Bengal, Chin Hills and Arakan.

(3) *Amaurornis fuscus erythrothorax.* The Chinese Ruddy Crake.

Gallinula erythrothorax Temm. and Schlegel, Fauna Jap. Aves, p. 121, pl. 28, 1849, Japan.

This is the largest and palest of all the known forms, the wing 105 to 120 mm. ; the lower parts a paler rufous and the crown less rufous anteriorly. This form occurs only, as far as is yet known, in the Shan States within our limits. Outside these it ranges from Japan and China to Yunnan and Siam.

(4) *Amaurornis fuscus zeylonicus.* The Ceylon Ruddy Crake.

Amaurornis fuscus zeylonicus Stuart Baker, Bull. B. O. C. Jan. 1927.

A small form about equal in size to *A. f. fusca* but much paler and faintly tinged above with yellowish. Omitting one very faded specimen, the darkest Ceylon bird is not quite so dark as the palest Javan or Malayan specimen. Ceylon and South-West coast of India to Belgaum and Kanara.

Description.—Forehead and crown to the sinciput, sides of the head and neck, lower plumage to abdomen vinous chestnut ; upper plumage dark olive brown, the rump, upper tail coverts, tail and wing quills darker brown ; flanks and abdomen olive brown ; under tail-coverts blackish-brown, edged with white ; chin and centre of throat white more or less tinged with chestnut.

Colours of soft parts.—Iris crimson, brown in young birds, glaucous blue-brown in nestlings ; bill horny green to brownish green, the tip of the lower mandible yellowish ; eyelids plumbeous grey with a red rim ; legs and feet reddish-orange to brick red.

Measurements.—A. f. fusca. Total length about 220 to 230 mm. ; wing 87 to 99 mm. ; tail about 55 mm. ; culmen 19 to 21 mm. ; tarsus 37 mm.

A. f. erythrothorax. Wing 105 to 122 mm. ; culmen 21 to 24 mm.

A. f. bakeri. Wing 97 to 110 mm. ; culmen 21 to 24 mm.

A. f. zeylonicus. Wing 87 to 96 mm. ; culmen 19 to 20 mm.

As already noted, the depth of colour varies in the different geographical races, but the above description fits them all.

Young Birds are darker above, and have the crown concolorous with the back ; supercilia, sides of head and neck and lower surface dull white barred everywhere with dusky brown ; flanks and thighs dull olive-brown ; under tail-coverts as in adults.

Nestling black with fulvous spots behind the ear-coverts.

Distribution : *vide supra.*

Nidification.—The Ruddy Crake breeds wherever it is found, though birds may move about considerably under the effect of drought, heavy rainfall or other local conditions, whilst it is possible that many of the rails which swarm in the swamps and lakes of Eastern Bengal in Winter breed further north. I have personally found them breeding in the Sunderbands of E. Bengal, Mymensingh and the Surma Valley in June, July and August whilst in Kashmir, Osmaston and others have taken eggs from May to September. In South Siam, Herbert found it breeding in July, whilst in Ceylon eggs have been taken in August and September, and in Travancore in June. Further north, Davidson took nests with eggs in Kanara from May on to August. The nest is a fairly substantial pad of grass, rush blades or similar materials, which is placed either on or quite close to the ground in swampy places, marshy fields or in islands in the middle of swamps. Occasionally the nest is placed in reeds, rank grass or bushes growing in water, but this is exceptional. The eggs generally number 5 or 6, more rarely 7 or even 8. The ground colour is a pale cream, sometimes a little deeper, and sometimes almost white, whilst every now and then one comes across a clutch of an almost deep red-pink. The marks consist of numerous ill-defined flecks, irregular blotches and spots of rufous-brown to deep reddish-brown, fairly numerous over the whole surface and generally more so at the larger end; the secondary markings, not always visible, are similar but more scanty and of a pale mauve, neutral tint or reddish-lilac. The surface is smooth but not glossy, and the texture strong and close. Thirty-four eggs of the southern form average 30·0 × 22·5 mm.; one hundred of the northern form average 32·3 × 23·7 mm.; whilst the only two clutches which I have seen of the Malayan bird were only about 29·0 × 23·0 mm., and were broader in comparison than any of the others. Typically they are rather smudgy ill-marked eggs compared with the more boldly spotted eggs of *Hypotænidia*.

Habits.—The Ruddy Crake is possibly a much more common bird than people imagine, but it is such a desperate little skulker that it is most difficult to flush. When snipe-shooting in Eastern Bengal we often found that in the hotter hours of the day the snipe deserted the rice fields and shallow mud and water round the edge of the swamps, taking refuge from the heat under the lilies, lotuses and other plants growing in deeper water. It was whilst pursuing these snipe that I first came across this very attractive little Crake. There was no chance in this deep water of running, so that any birds we disturbed were forced to fly and, in consequence, we were constantly putting up tiny birds which flew much like quails for two or three hundred yards and then, after swerving a little to the right or left, dropped suddenly down to the water plants again. The legs were always visible as they rose so that I guessed them to be rails of some kind, and shooting one found it to be a Ruddy Crake. As long as the sun was high and hot we could be sure of putting up any number of these quaint little birds, though shooting in the early mornings and late afternoons one but seldom saw them as they were then feeding where the cover was ample, and they could escape without flying. Their diet is both insectivorous and vegetarian and they, sometimes at least, also eat tiny fresh water molluscs. Its note, so far as I have heard it, is a very soft *crake*, not rapidly repeated but uttered as a single note at considerable intervals. It appears to be uttered only in the very early mornings and the evenings, and then but rarely. Hume syllabifies this as *keek-keek-keek*. Even where the birds were most numerous, as in the Sunderbunds, they were but seldom to be heard, though I was never in these districts during the breeding season when they may be more loquacious. They keep much to rice fields during the day, though they also haunt all kinds of swamps and marshes and may sometimes be found in marshy meadows at a considerable distance from any water. Round about villages, they may sometimes be seen on quite small pieces of water and they then become quite used to humanity and very tame. They seem good-tempered little birds, several pairs feeding in company without squabbling or fighting, even at the commencement of the breeding season. For the table they are of no use, though Hume says that when skinned and disguised with onions, etc., they are quite eatable.

AMAURORNIS PHŒNICURUS

The White-breasted Water Hen

The White-breasted Water Hen has three geographical races within our limits, including the typical form. These are :—

(1) *Amaurornis phœnicurus phœnicurus.* The Ceylon White-breasted Water Hen.

Rallus phœnicurus Pennant, Ind. Zool., ix. p. 10, 1769, Ceylon. Inhabiting Ceylon and South Travancore only.

(2) *Amaurornis phœnicurus chinensis.*—The Chinese White-breasted Water Hen.

Fulica chinensis, Boddaert, Tabl. Pl. Enl. p. 54, 1783, China. Found throughout India, Burma, China.

(3) *Amaurornis phœnicurus insularis.*—The Andaman White-breasted Water Hen.

Amaurornis insularis Sharpe, Cat. B. M. xxiii, p. 163, 1894, Andamans.

Known from the Andamans only.

Rather larger than either of the two preceding birds, and darker and blacker in general colour, with more extended white on the forehead.

Vernacular Names.—Dawak, *Dahak*, *Dauk* (Hin.); *Kimati* (Oudh); *Kurahi* (Sind.); *Kureyn* (Gond); *Bole-Radi* (Tel.); *Tannin Koli*, *Kannung Koli* (Tam. Ceylon); *Kulu-quet* (Burm.); *Di-dao-ho-gophu* (Cachari).

Description.—Forehead, supercilia, sides of the head, chin to vent pure white; upper parts, wings and sides of the body from breast to vent dark slaty-grey more or less washed with olive, and the upper tail-coverts generally browner; tail and wing quills blackish, the first primary with white outer web, posterior flanks, thigh-coverts, vent and under tail-coverts dingy rufous; axillaries and under wing-coverts slaty edged with white.

Colours of soft parts.—Iris brown in the young to crimson in the breeding male; bill green, the base of the upper mandible red, the tip and lower mandible paler and more yellow; legs and feet dull chrome-yellow to yellowish-green.

Measurements.—A. phœnicurus phœnicurus.—Total length about 320 mm.; wing 142 to 160 mm.; tail 58 to 66 mm.; tarsus 49 to 57 mm.; culmen 35 to 42 mm.

A. p. chinensis. Wing 158 to 173 mm.; culmen 36 to 41 mm.

A. p. insularis. Wing 157 to 173 mm.; culmen 37 to 44 mm.

Young Birds have the feathers of the forehead and face tipped with slaty and the white obscured; the upper parts generally are olive-brown rather than slaty-gray.

Distribution.—As given above.

Nidification.—The White-breasted Water Hen breeds from June to September over the greater part of the area in which it is found but Messrs. Wait, Phillips and Jenkins have taken eggs in almost every month of the year in Ceylon, whilst in Assam, Burma and China many birds commence breeding in May. The commencement of their breeding agrees in fact, as it does with other water-birds in the tropics, with the break of the rains. As soon as the swamps and lakes begin to fill, the birds set about their domestic duties, and by the time the insect world is at its worst and thickest, the eggs hatch and the young have a super-abundance of food. So entirely are nesting proceedings governed by the rainfall that the breeding commences late or early just as the rain itself is late or early, whilst in some seasons of drought the birds desert the driest areas altogether and betake themselves to more congenial surroundings, or, if they remain, do not breed at all. The nest varies very much both in character and in position. Sometimes it is placed in among tangles of reeds, coarse grass, cane brakes, or any of the other forms of vegetation which grow either in the swamps or immediately round them. In these cases the nest may be just clear of the water or as much as two or three feet above it, whilst in appearance it is just a heavy, large edition of that of the common Coot or Moorhen. At other times it is built quite high up in bushes, trees or palms and it is then often made of twigs, creepers and such other material as may be handy for the purpose. Oates states that most of the nests he found in South Burma were high up in trees, not below ten feet. In Assam most of our nests were found close above the water, but one we found high up in a pepul tree and another pair of birds had laid in the deserted nest of a Fish-eagle. I have seen many hundred nests, and think six or seven eggs is the number most often laid, and four or five only are often found incubated. Bingham found eight to be the normal full clutch in Tenasserim, but, on the other hand, in Ceylon, three or four eggs only are normally laid and five is exceptional. In shape the eggs are rather long ovals, very obtuse at the smaller end and sometimes rather cylindrical. The surface is fairly smooth and fine and sometimes faintly glossy. The ground colour varies from a very faint yellow-cream to yellowish-stone or pale buff, never of any great depth. The markings consist of blotches and spots, irregular and, generally, rather longitudinal in shape, scattered sparsely over the whole surface and rather more numerous at the larger end. The primary or superficial characters are light reddish-brick to rather dark brownish-red, whilst the secondary or underlying marks are lavender grey, neutral tint or purplish. The eggs are very like those of the Ruddy Crake except in size. The average sizes for the eggs of the various races are as follows:—

A. p. chinensis. 100 eggs 40·5 × 29·7 mm.

A. p. insularis. 50 eggs 40·8 × 31·0 mm.
A. p. phœnicurus. 40 eggs 36·8 × 30·0 mm.
Maxima 45·0 × 30·0 mm. (Burma) and 43·0 × *32·2* mm. (Andamans).
Minima 37·0 × *28·0* mm. (Ceylon).

Habits.—This Rail is, I think, much less of a skulker than most of its tribe and its larger size, also, makes it a less easy matter to hide. It, of course, keeps as a rule closely to cover, more especially to reeds, rushes and cane brakes, whilst at other times it creeps about in the forest and jungle surrounding the swamps, lakes or ponds in which it feeds in the mornings and evenings. At the same time it may often be seen wandering about over the water weeds, or swimming from one patch of cover to another, quite in the open, and I have often watched them feeding for half an hour at a time. They are very active walkers over weeds and lotus leaves, moving with rather long, deliberate strides, each foot lifted high and the tail jerking in unison with each step whilst every now and then there is an additional quick jerk upwards. It is, on the whole, a bold bird and may often be seen wandering about on the banks of village, ponds and ditches and, indeed, often breeds on these. It feeds on shoots of rice and water plants, reeds, grain, insects, mollusca and worms, etc. It is a noisy bird in the breeding seasons, and emits sounds quite astonishing for the size of the bird. E. H. Aitken describes its breeding call thus :—

> ' Anything more unearthly proceeding from the throat of a bird I never heard. It began with loud, harsh roars which might have been elicited from a bear by roasting it slowly over a large fire, then suddenly changes to a clear note repeated like the coo of a dove.'

They are pugnacious birds, and two cocks meeting in the open during the breeding season are sure to fight, but the damage done seems never to be serious, and they never continue the scrap with the pertinacity of the Water-Cock.

AMAURORNIS AKOOL AKOOL

The Brown Crake

Rallus akool Sykes, P.Z.S., 1832, p. 164, Deccan.

Vernacular Names.—None recorded.

Description.—Whole upper parts, wings and tail dark olive-brown, the quills rather darker brown and less olive ; lores, indistinct supercilia, sides of head and neck and lower plumage ashy-grey, passing into brown on the posterior abdomen, vent and under tail-coverts ; chin and centre of throat whitish passing into the grey of the surrounding parts.

Colours of soft parts.—Iris brown in young birds to blood-red in breeding males ; bill greenish-horny or pale-green, more blue at the tip ; legs and feet fleshy-brown to livid purple.

Measurements.—Wing 114 to 131 mm. ; tail 54 to 63 mm. ; tarsus 46 to 51 mm. ; culmen 28 to 32 mm. Females average smaller than males.

Chick in down.—Black.

Distribution.—Northern India from Kashmir to Gowhati in West Assam ; south to Bengal, Behar, Central Provinces, the South

Deccan, Mysore and Rajputana. I cannot trace any specimen from North Khasia Hills, nor did I ever see it there myself. There is on the other hand a specimen from Gowhati in the Kamroop District.

Nidification.—The Brown Crake breeds from May to September, making a pad nest of reeds, grass or rushes, and water weeds either in among the reeds quite close above the water or a more substantial nest of the same materials mixed with twigs, leaves and creepers which it places in a thick bush or tangle of canes in or close to the water. Occasionally it makes use of a bush in thick undergrowth some distance from any swamp or open water but nine nests out of every ten will be found practically in the swamp or alongside the margins. The nest is nearly always well concealed, and, as it is small for the size of the bird, is not easy to find. The number of eggs laid varies from four to six, and in appearance they are very like rather richly coloured eggs of the Common Water-Rail. The normal shape is a broad, blunt oval, almost spheroid, and the texture is very fine and close, often well glossed. The ground colour is anything from a pale yellow—or pinkish-stone to a warm salmon or buff. The markings consist of fairly bold, well-defined spots and blotches of pale reddish-brown to deep reddish-purple, scanty everywhere but rather less so at the larger end.

Fifty eggs average 34·9 × 26·5 mm.; *Maxima 38·8* × 27·2 and 37·7 × 28·0 mm.; *Minima 31·8* × 26·7 and 34·9 × *25·2* mm.

Habits.—Blewitt sixty years ago gave an admirable account of this Rail. He writes :—

> ' I have met with it nearly always singly, occasionally in pairs. Its favourite resorts are swamps, the reeds and bushes on the edge of streams, and the tangled amphibious coverts on the border of water-courses. A favourite place of abode too is the marshy ground occupied by Keurak Plants, the branches and broad leaves of which it ascends like *Erythra phœnicura*, with wonderful agility. I have always found it a shy bird, seeking at once a place of security on the slightest alarm. Frequently I have witnessed it half emerge from the rushes, either to feed or change its retreat, and then pause, carefully scanning the neighbourhood before venturing onward. When walking, it ever and anon jerks up its short tail. It runs with rapidity, and when once concealed it is very difficult to flush it; indeed, it would appear rightly to trust far more for safety to its speed of foot and aptitude for concealment than to its powers of flight.
>
> " Slowly and heavily does it fly, and never to any distance, and with good dogs it may be run down and secured. This Rail has a short plaintive note, which, however, I have only heard it utter at daybreak and just before sunset." '

It by no means always keeps to marshes and swamps, but often seems to feed on dry and even on open ground where much of its food consists of land snails, slugs, worms, etc. Like the rest of the Rails, it is a shy, secretive bird, avoiding observation.

AMAUROKNIS BICOLOR

Elwes' Crake

Porzana bicolor Walden, Ann. Mag. Nat. His. 4), iv, p. 47, 1872, Sikkim.

Vernacular Names. None recorded.

Description.—Head, neck and lower plumage dark ashy grey, darkest on the crown and nape and paler on the sides of the head, changing to albescent on the chin; upper parts, wing-coverts and inner secondaries rich brownish-rufous; tail black; wing-quills dark brown.

Colours of soft parts.—Iris brown in the young to blood-red in breeding males; bill pale glaucous-green tipped paler and greyer and with a red patch near the base, more vivid in the breeding season; legs and feet dull red to rather bright brick-red.

Measurements.—Wing 112 to 119 mm.; tail 57 to 60 mm.; tarsus 37 to 39 mm.; culmen 21 to 27 mm.

Distribution.—Nepal and Sikkim to Eastern Assam; Khasia and Cachar Hills, Manipur and Northern Burma to Yunnan and the Shan States.

Nidification.—This Crake breeds in considerable numbers in the Khasia Hills, as also in the North Cachar Hills in the few places suitable to it. In Sikkim it is said to breed between 4,000 and 6,000 feet, but in Assam we took nests anywhere above 3,000 feet, whilst in Dibrugarh it was not uncommon practically down to the foothills. Most of the nests personally found by me were in quite small patches of jungle round about, or between, rice fields at an elevation of some 5,500 feet. Here they were very numerous, and I found nearly a dozen birds breeding in a small patch about 100 yards long by 60 wide. The nest differed in no way from that of the Brown Crake and was usually built a few inches above the water, though one was built up in a rhododendron tree in deep forest and some way from water.

The eggs only differ from those of the Brown Crake in being more richly coloured. 80 eggs average 33·9 × 26·1 mm.; *Maxima 36·3* × 25·3 and 35·3 × *27·0* mm.; *Minima 31·3* × 26·1 and 32·3 × *25·1* mm.

The breeding season is from the middle of May to the end of August, and the number of eggs laid varies from 5 to 7.

Habits.—The habits of Elwes' Crake are much the same as those of the Brown Crake. In the hills south of the Brahmapootra we found it kept to patches of jungle, scrub and rushes between or round the rice cultivation or, where there was none of this, to small ponds and pools in or near forest. They also frequented small streams, especially those which had plenty of cover on one side and open grass land on the opposite one. They often came out of the cover in the early mornings and late evenings and fed on the grass land, picking up small grasshoppers, land shells and small worms. On the least sign of danger they scuttled down to the bank and either swam or flew to the cover on the far side. When frightened they ran with head and tail depressed and covered the ground at a great pace, but at other times their walk was the usual slow jerky movement affected by all Rails. I have never heard their call, even in the breeding season, though I attributed to this bird a deep grunting noise, very loud and resonant, which I sometimes heard, late in the evening, in their favourite haunts.

RALLINA SUPERCILIARIS SUPERCILIARIS

The Banded Crake

Rallus superciliaris Eyton, Ann. Mag. Nat. His., xiv, p. 230, 1834, Malay Peninsula.

Rallina superciliaris, Blanf. and Oates, iv, p. 167.

Vernacular Names.—Daobui-lai (Cachari).

Description.—Chin and throat pure white, in younger birds more or less tinged with rufous; head, neck and breast chestnut; remaining upper parts and wing-coverts dark brown slightly washed with olive; wing-quills dark brown; lower breast, abdomen and under parts barred black and white, the centre of the abdomen practically unmarked with black.

Colours of soft parts.—Iris crimson-red or blood-red; bill green, the terminal half of the upper mandible and tip of lower dark brown; legs dull greenish-plumbeous, plumbeous or black.

Measurements.—Total length about 250 mm.; wing 122 to 132 mm.; tail 55 to 64 mm.; tarsus 39 to 46 mm.; culmen 27 to 28 mm.

Young birds have the upper parts of the head and neck concolorous with the back; sides of the head and neck more ashy-brown; breast brown; inner webs of quills more or less barred with dull white, a few white and black bars on scapulars and wing-coverts.

Irides dull brown; legs greenish-plumbeous.

Distribution.—Ceylon and the sub-Himalayas from the North-West Frontier to E. Assam. Thence in small numbers here and there throughout the well-wooded, wetter parts of India. It also occurs in South Burma, the Malay States and Annam.

In the Philippines its place is taken by *R. s. eurizonoides*, a race with deeper rufous colour and either no white or very little on the chin and throat.

Nidification.—In 1900 and succeeding years General R. M. Betham found this bird breeding in considerable numbers on the ghats near Khandalla. In some notes to me he writes:—

> 'This rail is apparently common on the ghats at Khandalla, near Poona, during the monsoon. It was probably overlooked as so few people visit these spots at this season, owing to the excessive rainfall.
>
> 'My shikari first brought me the eggs which were puzzling as they were so unlike other rails. He, however, managed to secure the bird with the eggs so we were fortunately able to identify them.
>
> 'It breeds in thick jungle or, rather, in dense tangles of bushes and other vegetation, and its nest is not easy to find.'

Prior to this in 1898 Bell and Hervey had already taken many of its nests and eggs round about Kanara. This is recorded in this Journal (vol. xiv, p. 394) as follows:—

> 'We found that the Banded Crake was a fairly common bird in the jungles along the coast during the monsoon, and we obtained altogether some dozen nests with eggs varying in number from 4 to 7 in the clutch, besides finding many empty ones. All the nests with eggs were found in the months of June to September, i.e., during the heavy rains. Many nests were found robbed of their contents by mongooses, etc., the empty egg-shells lying on the ground below, some few there were in which the eggs were rotten. The nests are placed in bamboo clumps, on creeper masses, on the top of a tree stump, etc., and were, at the most, six feet from the ground. The size of the egg is about 1·30″ × 1″ on an average; one of the largest out of a series of 50 measures 1·40″ × 1·20″. The birds breed in the densest jungles as well as in the scrub jungle, from sea level up to the tops of the highest hills, which are here about 1,800 feet.'

Including Bell's figures the average for 90 eggs is 33·7 × 26·0 mm.; *Maxima 35·8* × 25·4 mm. and 35·1 × *28·1* mm.; *Minima 30·9* × *25·0* mm. The texture of the eggs is *sui generis;* something between the thick shiny, chalky texture of the egg of the Crow-pheasants and that of the Herons, but nearer the former, and it is most interesting to find that the eggs of these two primitive birds, the Rails and the non-parasitic Cuckoos, should be so much alike and so reptilian in character. In shape the eggs are very round, blunt ovals.

Osmaston took two nests containing 7 and 5 eggs respectively in June and July near Dehra Dun. In the latter case the parent bird attacked his hand, leaving her nest for the purpose, and then returned to sit on her eggs. The native shikaris told Betham that they sat very tight and would almost allow themselves to be captured by hand.

Habits.—Bell's comments on the habits of these Rails forms an excellent summary:—

> 'What Mr. Davidson says about its habit of calling in the mornings and evenings is correct; but it calls at other times during wet, misty weather. The cry is rather like that of the common hen after laying an egg; but there is a difference. Suddenly disturbed, it utters the cry of the common paddy bird (*Ardeola grayi*) when alarmed; if suspicious of danger it makes a noise like '*k—r—r—r—r—r*'; pronounced in a subdued voice. It is extremely shy of open ground, and will invariably fly across even a few feet of open path in the jungle. When flushed it takes to the nearest tree or any thickly foliaged place available and is quite at home perched on a branch. We have put up many during our walks, generally with dogs. I have never seen one during the dry months, though I am constantly in their breeding haunts during that time. Whether they migrate or not from the district we do not know for certain, but it seems probable.

> In the jungles they go about with their wings slightly hanging. They feed on insects.'

As regards their migration it is unlikely that they will be found to do more than move locally if even that. It seems probable that in the dry season they move away to those swamps and lakes which never dry up even in the longest droughts, so it ma ybe that they move north to those limitless wet areas lying below the foot-hills of the Himalayas. Even this, to me, seems unlikely and, when we have unravelled the mystery of their movements, we may find that they are very restricted.

RALLINA FASCIATA

The Malayan Banded Crake

Rallus fasciatus Raffles, Trans. Lin. Soc., xiii, p. 328, 1822, Malay Peninsula.

Rallina fasciata, Blanf. and Oates, iv, p. 169.

Vernacular Names.—None recorded.

Description.—Whole head, neck and breast deep chestnut, the chin and throat often a little paler and the crown darkest; remaining upper parts, scapulars and innermost secondaries rufous-brown; wing-coverts black with broad white bars; quills dark brown, barred on both webs with whitish; below broadly barred with black and white, the latter more or less rufous on the longest feathers.

Colours of soft parts.—Iris crimson or blood-red; bill blackish, the base paler and tinged with greenish or plumbeous-slate; gape and orbital skin crimson; legs and feet coral-red; claws slate or horny-blue.

Measurements.—Length about 240 to 250 mm.; wing 118 to 131 mm.; tail 49 to 51 mm.; tarsus 42 to 48 mm.; culmen 20 to 21 mm.

Young Birds have the head and neck the same colour as the back; the breast is pale dull brown and the remaining under parts are whitish obscurely marked with brown bars.

Distribution.—From Karennee and Rangoon south through the Malay Peninsula to the Celebes and Moluccas, Borneo, Java and Sumatra.

Nidification.—There appears to be nothing on record about the breeding of this Rail, but Mr. Kellow took several sets of eggs for me near Simpang in the Federated Malay States. The nests were said to be rather rough platforms of grass, twigs and other scraps of vegetation placed on or under bushes in small ravines a long way from any water. In 1904 Wickham took a nest with 5 eggs. The nest was said to be

> 'a pad of dead bamboo leaves with a few dry twigs placed on the ground under the thin cover of a small bush. I made many attempts to secure the old bird—one including three devices, one cast with a fishing net in the daytime, twice shot at (once on the nest), and the setting of nooses; in spite of all these failures I was lucky enough to get the old male caught on the nest at night with a cast-net. The nest was in a small patch of bamboo tree jungle, rather dark, not very thick undergrowth in the bend of a stream which dries up in the hot weather,

leaving perhaps a pool or two, but was at this time a flowing stream ; the particular patch of jungle used bordering the paddy land.'

The nest was taken on June 29.

Mr. Hopwood also obtained a nest of this bird containing four eggs, quite fresh. This nest, as well as those from Simpang, were all taken in August. It contained four eggs which together with the Malay ones are now in my collection. They are of the same curious texture, shape and colour as those of *R. superciliaris.* They average 31·5 × 23·9 mm. ; *Maxima 35·0 × 25·4* mm. ; *Minima 27·2 × 21·9* mm.

Habits.—Much the same as those of the preceding bird, and probably like it resident wherever found, in spite of the fact that so many are caught taking refuge in houses in a completely exhausted condition. The first bird I ever saw was a young female caught by one of my servants in their house, very exhausted when caught, but reviving at once and fiercely attacking the hands of her capturer, uttering hoarse grunts rather like a dog growling. Probably she had been pursued by some nocturnal vermin, and took shelter in the first hiding-place she found. This was in North Cachar in December at about 2,500 feet. I also found this bird breeding there, capturing a hen bird and one young—out of several—on her nest. It must be as great a skulker as any other Rail, for I hardly ever saw one unless accompanied by dogs, as nothing would make them fly and, far from flying across open paths in the jungle, they always scuttled across as hard as they could. In Assam it was a bird of dense jungles only, but in Lower Burma and the Malay States it seems to come more into jungle surrounding villages and cultivation.

RALLINA CANNINGI

The Andamanese Banded Crake

Euryzona canningi (Tytler), Blyth, Ibis, 1863, p. 119. Port Canning, Andamans.

Rallina canningi, Blanf. & Oates, iv, p. 169.

Vernacular Names.—None.

Description.—Whole upper plumage, head, neck, breast and inner secondaries deep chestnut ; wing-coverts the same, but a few of the median and greater obsoletely barred with white and dark brown ; primaries and outer secondaries dark brown edged with chestnut barred on the inner webs with whitish, and also, less distinctly on the outer webs of the first two or three primaries, lower parts boldly barred with black and white.

Colours of soft parts.—Iris red ; bill pale-green ; legs and feet olive-green.

Measurements.—Total length 325 to 350 mm. ; wing 151 to 163 mm. ; tail 73 to 92 mm. ; tarsus 56 to 62 mm. ; culmen 29 to 33 mm. As usual in Rails, the males exceed the females in *average* measurements, though there is much overlapping in size.

Distribution.—The Andaman Islands.

Nidification.—Osmaston obtained a fine series of the nests and eggs of this Rail in 1907, whilst Wickham and Anderson obtained others later. All these nests appear to have been made of dead leaves, grass and rushes and to have been placed on the ground in marshy land or on the borders of streams in dense forest. In one case only does the record show that the nest was placed on a thick bush above the ground at a height of some three feet.

The nests contained 3 to 5 eggs of the same texture and colour as those of the other *Rallinas* but the chalky covering with its shiny yellowish surface is perhaps rather more pronounced. Thirty-two eggs average 40·6 × 30·8 mm.; *Maxima 43·1* × 30·8 and 41·3 × *32·0* mm.; *Minima 37·2* × 30·0 and 39·4 × *29·7* mm.

Habits.—There is nothing on record about this Rail beyond Wimberly's remarks of nearly 50 years ago:—

> 'This is an extremely shy, and, I believe, exclusively a forest bird. It certainly never leaves cover during the daytime. It is found either in the forest itself or in thick secondary scrub adjoining this, and especially where the ground is swampy or intersected by hill streams.
>
> 'If driven out of cover it will not take wing unless hard-pressed, when its flight is slow and heavy.
>
> 'Its food appears to consist of insects and fresh-water fish. The latter I infer, as some of those I sent you were taken in snares laid on the ground baited with fresh-water shrimps which were all eaten.
>
> 'I have never heard the call notes, but the man I employed to snare some of my specimens tells me that its call is very similar to that of the Andamanese Banded Rail.'

Later Osmaston endorsed all the above marks and he has also proved it to be a very common bird in the Andaman Islands.

(*To be continued*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. Blatter, S.J., Ph.D., F.L.S.

Part III

(Continued from page 917 of Vol. xxxi)

GRAMINEÆ (Cke. ii, 907)

BY

E. Blatter and C. McCann

We have decided to take up the *Gramineæ* for several reasons. Since Cooke's publication of this family several new species have been described and McCann has added over 50 species which are new to the Presidency. More important than the numerical additions are the changes made during the last fifteen years with regard to the general arrangement of the grasses and the definition of certain genera. A great amount of work has been done in Europe as well as in America. In Europe it was chiefly O. Stapf who, with his vast experience of the grass-flora of many countries and the rich material of the Kew Herbarium at his disposal, has advanced our knowledge of the grasses and their systematic co-ordination more than anybody else. A comparison of his monograph of the grasses in the Flora of Tropical Africa which is still in progress with that of the Flora Capensis shows at once in which direction and to what extent progress has been made. As regards the second subfamily *Pooideæ* the two works reveal only minor changes; but considerable changes were found necessary in the first subfamily *Panicoideæ*. Here again it is chiefly the genera *Andropogon* and *Panicum* and their allies which have been affected. In this respect, especially where the tribe of *Paniceæ* is concerned, we owe a good deal to American botanists. It was chiefly the fact that there were no definite dividing lines for the genera of *Andpropogoneæ* and *Paniceæ*, that induced Stapf not 'to unite the groups wherever intermediate links can be detected,' which would bring about endless confusion, but 'to be satisfied with approximately definable groups, which can on the whole be easily grasped and remembered.' In other words, it is preferable from a practical point of view to adopt smaller genera than unmanageable large genera for merely theoretical reasons. As the Kew Herbarium, as far as the grasses are concerned, owes its systematic arrangement entirely to Stapf, and as colonial workers will always appeal to Kew in their difficulties, we thought it advisable to follow Stapf in the definition and sequence of the tribes as laid down in the Flora of Tropical Africa. As of late the grass-problems have received renewed attention by the Agricultural Departments in India, we do not consider it superfluous to bring the systematic account of the grasses of Bombay up-to-date.

An asterisk in front of a name means that the particular genus or species has been introduced.

Two complete keys, one natural and one artificial will be given at the end.

SUBFAMILY I. PANICOIDEÆ

The mature spikelets fall entire from their pedicels or with them, all are alike or differ in sex and structure. Perfect spikelets with 2 heteromorphous florets, the upper hermaphrodite, the lower male or barren. Rhachilla not continued beyond the upper floret.

TRIBE I. *Mayideæ.*—Sexes borne on different inflorescences on the same plant or the female spikelets at the base of the inflorescence, and the male above them. The male spikelets in pairs, one sessile, the other pedicelled, or both pedicelled, in spike-like solitary or panicled racemes, 2-flowered. Glumes membranous or chartaceous, enclosing the florets. Valves more or less hyaline, awnless. The female spikelets solitary with or without a rudimentary pedicelled companion, 1-flowered. Glumes firm, at least the lower which ultimately often becomes bony, or both thin and more or less hyaline. Valves hyaline, awnless.

1. Male and female spikelets in separate inflorescences. Male spikelets in a large terminal panicle. The female spikelets in the axils of the leaves
    (*a*) Female spikes distinct, articulated ... ... *1. *Euchlæna.*
    (*b*) Female spikes grown together into a spongy more or less cylindrical body ... ... *2. *Zea.*
2. Male and female spikelets in separate portions of the same spike, the female below.
    (*a*) Grain enclosed in the usually globose or ovoid ivory-like capsuliform supporting sheath ... 3. *Coix.*
    (*b*) Grain enclosed in the hardened outer glumes ... 4. *Polytoca.*

*1. EUCHLÆNA, Schrad.

Stout and tall annuals with leaves very broadly linear or oblong. Male spikelets 2-nate (sessile and pedicellate) on the spiciform fascicled branches of a terminal panicle, 2-flowered with coriaceous glumes. Female spikelets in 2-ranked spikes which are clustered in the leaf-axils, not fused as in the Maize, joints rhomboidal, oblique, articulate, excavate, with the margins of the excavation embracing the cartilaginous outer glume and with it forming a smooth pseudocarp.

*1. **Euchlæna mexicana,** Schrad. Ind. Sem. Hort. Götting. (1832), var. *luxurians ;* H.H. Mann in Bull. 77, Dept. of Agric., Bombay.—*Reana luxurians,* Dur. in Bull. Soc. Acclim. Sér. II, IX (1872), 581.

Vern. name : Teosinte.

Description : A large, very succulent, strong growing, annual grass, 30 cm.–3 m. high. Leaves long, 5–7·5 cm. broad. Male spikelets 8–9 mm. long, crowded in long spikes in a corymb 15–25 cm. long. Female spikes in the leaf-axils. Styles very long, protruding from the top of the enclosing leaf-sheath. The spike of the female spikelets breaking up at maturity into rhomboidal seed-like joints. Nearly allied to Maize and resembling it in its tassel of male flowers and broad leaves. A single plant often sends up 100 stems.

Locality : Cultivated in the Ganeshkhind Botanic Garden.

Distribution : A native of Guatemala.

Uses : Cultivated for green fodder, but it does not stand drought well. Horses are fond of it.

*2. ZEA, Linn. (Cke. ii, 1051, Stapf. Fl. Trop. Afr. ix, 26)

Tall, stout, annual grasses with large leaves, the axils of the lower bearing the female inflorescences (cobs), tightly enveloped by large membranous bracts. Sexes in different inflorescences on the same plant. Male inflorescence terminal, of panicled spike-like racemes with 2-nate spikelets shortly unequally pedicelled or one sessile on the inarticulate rhachis, both similar, 2-flowered, awnless. Glumes subequal, membranous, convex, obscurely 2-keeled, 9–10-nerved. Valves more or less hyaline, 3–5-nerved ; valvules similar, 2-nerved, obscurely keeled ; lodicules 2, fleshy. Stamens 3 ; anthers linear. Female spikelets 2-nate in 4–11 longitudinal rows, slightly immersed in the spongy axis of the cob, with a lower barren and an upper fertile floret, awnless. Glumes similar, very broad, fleshy below, hyaline above, nerveless, ciliate. Lower valve resembling the glumes, but shorter and ciliate, with or without a similar but smaller valvule ; upper valve similar to the lower with a valvule about as long as the ovary. Lodicules 0. Ovary obliquely ovoid. Style very long, 2-fid at the tip, papillose upwards, exserted in long silky tassels from the sheathing bracts. Grain large, subglobose or dorsally more or less flattened, surrounded by the dried up glumes, valves and valvules ; scutellum large, equalling or exceeding ⅔ of the grain.

Species 1.—A native of America.

*1. **Zea mays,** Linn. Sp. pl. ed. I, 971 ; Beauv. Agrost. 136, t. 24, fig. 3 ; Steud. Syn. Pl. Glum. I, 9 ; Bentl. and Trim. Med. Pl. t. 296 ; Duthie, Field and

Gard. Crops 25, t. 5; Koern. and Wern. Handb. d. Getreidebaues I, 330–378, II, 772–870; Harshberger, Maize, in Contrib. Lab. Univ. Pensylv. I (1893), 75–202; Nicholls, Text-book Trop. Agr. (1892), 260–265; Montgomery, Corn Crops (1913), 1–275; Davy, Maize (1914); Stapf. in Fl. Trop. Afr. IX, 26.

Vern. Names : Maize, Buta, Maka.

Description : Culms up to 3 m. high, sometimes more. Leaf-sheaths terete, more or less hairy upwards along the margin; ligule short, truncate, thinly membranous, more or less pubescent; blades linear-lanceolate, up to over 90 cm. long and 10 cm. wide, glabrous or almost so, tips often drooping. Male panicle up to over 20 cm. long; rhachis pubescent; spikelets up to 12 mm. long; anthers 6 mm. long Female spike (cob) and grains varying much in size and shape, the grains also in colour.

Locality : Cultivated widely in the Presidency as a forage for cattle and as a vegetable and for flour.

Origin : The origin of Maize is a much discussed question. Some are of opinion that it has been developed from Teosinte (*Euchlæna*), others that the original wild form has become extinct. A more acceptable opinion is that it is a hybrid between Teosinte and an unknown or extinct species resembling pod-corn, a variety of *Zea mays* in which each kernel is enveloped in the elongated floral bracts.[1]

Kuwada[2] who studied the number of chromosomes in Maize came to the conclusion that *Zea mays* was originally derived from the hybridization between *Euchlæna* and some unknown species of the tribe *Andropogoneæ*, long chromosomes belonging to the former and short ones to the latter, and that the nuclei of its various individuals possess both kinds of chromosomes in various combinations according to the law of chance.

To explain the structure of the ear of Maize, Collins published evidence which indicated that the ear may have developed through the twisting of yoked pairs of spikelets. Weatherwax[3] tries to refute this opinion. He contends that dropping of rows of seeds is due to the discontinuance of a row of paired spikelets and not to the loss of the pedicelled spikelets from yoked pairs, and that there is no indication that short rows represent long rows partially aborted, but that the abortion of spikelets or of rows in the ear seems to be much more constant as a characteristic of theories than of real ears.

Genetics of Maize : Those interested in Maize from a genetic point of view are referred to the more recent publications mentioned in the foot-note.[4]

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[1] Collins. The origin of maize. Journal Wash. Acad. Sci. 2 (1912), 520.

[2] Kuwada, Y. Die Chromosomenzahl von *Zea mays* L. Ein Beitrag zur Hypothese der Individualität der Chromosomen und zur Frage über die Herkunft von *Zea mays* L. Jour. Coll. Sci. Imperial Univ. Tokyo, 39 (1919), 1-148.

[3] Weatherwax, P. A misconception as to the structure of the ear of maize. Bull. Torrey Bot. Club, 47 (1920), 359–362.

[4] Blaringhem, L.—Production par traumatism d'une forme nouvelle de Mais à caryopses multiples, *Zea Mays* var. *Polysperma*. Compt. Rend. Acad. Sci. Paris 170, (1920), 677–679.

Collins, G. N.—Structure of the maize ear as indicated in *Zea-Euchlæna* hybrids. Jour. Agr. Res., 17 (1919), 127–135.

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Emerson, R. A.—The nature of bud variations as indicated by their mode of inheritance, Amer. Nat., 56 (1922), 64–79.

Hume, A. N.—A system for breeding corn or gregarious animals. Jour. Heredity, 11 (1920), 191–192.

Jones, D. F.—Segregation of susceptibility of parasitism in maize. Amer. Jour. Bot., 5 (1918), 295-300.

Jones, D. F.—The effect of inbreeding and crossbreeding upon development. Proc. Nation. Acad. Sc., 4 (1918), 246–250.

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Kempton, J. H.—Heritable characters of maize. Jour. Heredity, 11 (1920), 111–115.

3. Coix, Linn. (Cke. ii, 997).

Species 5 or 6.—Hot countries of the Old World.

Coix Lacryma-Jobi, Linn. Sp. Pl. ed. i, 972 ; Cke. ii, 997 ; Stapf in Fl. Trop. Afr. ix, 27.—*Coix Lacryma*, Linn. Syst. ed. x, 1261 ; Duthie, Grasses of N. W. India, 11, and Fodder Grass, N. Ind. 18.

Locality: Sind : Umarkot, sandy plains (Sabnis B717 !) ; Chuar Chemali, Indus River (Blatter and McCann D680 !) ; Mirpur Sakro (Blatter and McCann D681 ! D683 !) ; Gharo (Blatter and McCann D682 !).—*Gujarat :* (Graham).—*Khandesh* (McCann !) —*Konkan :* Gokhiwara, Bassein (Ryan 25 !) ; Matheran (Paranjpe !) ; Dohe Forests (Ryan 713 !) ; Junga Hill, Thana (Paranjpe !) ; Alibag, rice fields (Ezekiel !) ; Kenery Caves, foot (McCann 9876 !) ; Sion (McCann 8453 !) ; Bhandup, near tank (McCann 5098 !) ; Horse-shoe Valley, Ghatkoper (McCann 9877 !) : Common along line from Kalyan to Kasara in streams (McCann !).—*Deccan :* Lonavla (Garade ! McCann ! Woodrow) ; Khandala, common all over (McCann 9405 !); Purandhar (McCann 5005 !) ; Igatpuri (McCann 4346 !) ; Panchgani Ghat (Cooke) ; Panchgani (Blatter !).—*S. M. Country :* Devaryi (Sedgwick and Bell 4426 !) ; Dharwar (Sedgwick 1856 !).—*Kanara :* (McCann !) ; Common all through the Konkan and Deccan during the rains, filling up the banks of streams and fields.

Distribution : Tropical Asia, cultivated in Africa and America.

Uses : Used as fodder for cattle. Duthie says that they fatten on it. Haines calls it a poor fodder for cattle. Of the false fruits there are several varieties differing much in size, shape and colour, and used for decorative purposes in the place of beads. According to Stapf one variety with thin shells is an important cereal in Burma and in the Farther East. Waxy endosperm, first found in maize from China, Burma and the Phillippines, has been found now in *Coix Lacryma-Jobi* from the same region.[1]

4. Polytoca, Br. (Cke. ii, 998)

1. **Polytoca Cookii,** Stapf in Hook. Ic. Pl. 24 (1895) t. 2333 ; Cke. ii, 998.

Locality : Kathiawar : Junagad (Blatter). — *Konkan :* Tungar forest, Bassein (Bhide) ; Bombay (Dalzell) ; Salsette (Jacquemont 706). *Deccan :* Khandala (McCann 9881!) ; Igatpuri (McCann 9880!) ; near Mahableshwar (Woodrow[1]) ; Mahableshwar (Woodrow, Cooke). *Kanara :* (Lisboa).

Distribution : Apparently endemic in the Bombay Presidency.

2. **Polytoca barbata,** Stapf in Hook. f. F. B. I. vii (1896), 102 ; Cke. ii, 599. *Coix barbata*, Roxb. Fl. Ind. iii, 569 ; Dalz. and Gibs. Bombay Fl. 289. *Coix gigantea*, Herb. Russ. ex Wall Cat. No. 8626.—*Chionachne barbata*, Br. in Benn. Pl. Rar. Jav. 18 ; Aitchis, Cat. Panj. Pl. 157 ; Duthie Grass. N. W. Ind. 11, and Fodd. Grass. N. India, 19.

Locality : Gujarat : Chharodi farm (Gammie 16536 !) ; Nadiad farm (Herb. Econ. Bot. Poona!) ; Surat (Sedgwick !) ; Junagad, Kathiawar (Blatter 3784 !). *Khandesh :* Toranmal (McCann 9883 !) ; Taloda (Golne!). *Konkan :* Between Worli Fort and Hornby-Villard Road on bank, Bombay (Sabnis 9884 !) ; Thana (McCann !). *Deccan :* High hills round Junnar, Poona District (Dalzell and Gibson) ; Poona (Woodrow) ; College of Science, Poona (Herb. Econ. Bot. Poona !) ; Ganeshkhind Bot. Gard. (Herb. Econ. Bot. Poona !) ; Haveli (Herb. Econ. Bot. Poona !) ; near Sholapur (Woodrow !). *S. M. Country :* S. W. of Dharwar (Sedgwick and Bell 4433 !) ; Kunemelihalli (Sedgwick 1947 !) ; Kholapur (Woodrow !, Herb. Econ. Bot. Poona !). *Kanara :* Gersoppa Falls (Talbot !).

Distribution : India, Ceylon, Java.

Kempton J. H.—Linkage between brachytic culms and pericarp and cob color in maize. Jour Washington Ac. Sc. 11 (1920), 13-20.

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Richey, F. D.—The inequality of reciprocal corn crosses. Jour. Amer. Soc. Agron. 12 (1920), 186-196.

Urbain, A.—Influence des matières de réserve de l'albumen de la graine sur le development de l'embryon. Rév. Gén. Bot. 32 (1920), 125-139, 165-191.

[1] Kempton, J. H. Waxy endosperm in *Coix* and *sorghum.* Jour. Heredity, 12 (1921), 396-400.

TRIBE II. *Andropogoneæ.*—Spikelets usually in pairs, one sessile, the other pedicelled, very rarely both pedicelled, those of each pair usually alike as to sex (homogamous) or different (heterogamous) on the axes of variously arranged, often spike-like racemes. Glumes more or less rigid and firmer than the valves, and the lower always longer than the florets. Valves membranous, often hyaline, that of the upper floret awned or reduced to an awn or muticous.

The key to the genera of this tribe will be given below.

5. DIMERIA, R. Br.

Woodrowia diandra, Stapf. must be referred to this genus. The genus *Woodrowia*, therefore, disappears from the Bombay Flora,

I. Spikelets in 2–3-nate racemes. Annuals
  (*a*) Rhachis nearly straight. Awn long..................... 1. *D. ornithopoda.*
  (*b*) Rhachis circinately curved. Awn short.......... 2. *D. Woodrowii.*
II. Spikelets in many-nate racemes. Perennial.......... 3. *D. gracilis.*
III. Spikelets in panicles. Annual.................................. 4. *D. diandra.*

The species of this genus usually inhabit open, flat, dry, gravelly plains which are well drained during the monsoon, and several species may be found associated with each other in the same locality to the exclusion of every other plant. Where *D. ornithopoda*, *gracilis* and *diandra* grow together, the two former are more numerous.

1. **Dimeria ornithopoda,** Trin. Fund. Agrost. (1820), 167, t 14 ; Hack. Monogr. Androp. 81 ; Hook. f. in F. B. I. vii, 104 ; Cke. ii, 945.—*D. filiformis*, Hochst. in Hohenack. Pl. Ind. Or. no. 231.—*Andropogon filiformis*, Roxb Fl. Ind. i. 256.—*Andropogon Roxburghianus*, Schult. Mant. ii, 451.—*Psilostachys filiformis*, Dalz. and Gibs. Bomb. Fl. 305.

Description : Cke. l.c.

Locality : Konkan : Kankeshwar Hills, Alibag (Bhide !) ; Marmagoa (Talbot !) ; Vetora (Sabnis 33715!).—*Deccan :* Mahableshwar (Dalzell and Gibson, Lisboa) ; Lingmala to Mahableshwar, 4,000 ft., rain 200 inch. (Sedgwick and Bell 4653 !); Lonavla (Bhide !, Lisboa) ; Khandala, Tata's Lake, very common (McCann A309 !, 9885 !, Woodrow) ; Sakhar-Pathar, Lonavla (Gammie 15948 !) ; Panchgani (Blatter and Hallberg B1214 !, B1219 !, B1279 !, B1289 !, Woodrow).—*S. M. Country :* Castle Rock (Bhide !), Londa (Woodrow !).—*Kanara :* Yellapore (Sedgwick 3124 !) ; Birchy (Talbot 2251 !) ; Karwar (Hallberg and McCann A307 !) ; Siddhapur to Sirsi, open grass land (Hallberg and McCann A313 !) ; Jagalbet, N. Kanara (Talbot 1565).

Distribution : All over India, Malay Islands, Japan, Tropical Australia.

2. **Dimeria Woodrowii,** Stapf in Hook. Ic. Pl. 24 (1895), t. 2312 ; Hook. f. in F. B. I. vii, 104 ; Cke. ii, 945.

Description : Cke. l.c.

Locality : Konkan : Marmagoa (McCann !, Bhide !, Talbot 2557) ; Karanjee, Ratnagiri Dist. (Herb. Econ. Bot. Poona !) ; Ratnagiri (Herb. Dhura !, Woodrow).—*Kanara :* Mirjan (Hallberg and McCann !) ; Honavar, open rocks (McCann !).

Distribution : W. Peninsula.

3. **Dimeria gracilis,** Nees ex Steud. Syn. Gram. 413 ; Hack. Monogr. Androp. 88 ; Hook. f. in F. B. I. vii, 105 ; Cke. ii, 946.

Description : Cke. l.c.

Locality : Konkan : Penn, hills (Bhide !) ; Vetora (Sabnis 3714 !).—*Deccan :* Lonavla (Bhide !, Woodrow) ; Khandala (McCann A318 !) ; on the Ghats (Lisboa !).—*S. M. Country :* Castle Rock (Bhide !) ; Anmod to Castle Rock (Sedgwick 3254 !).—*Kanara :* Bell and Sedgwick 3165 ! ; Supa (Sedgwick and Bell 4880 !) ; Arbail Ghat (Sedgwick and Bell 5018 !) ; Sirsi (Gammie !) ; Kumwada (Talbot 2260 !) ; Yellapore (Talbot 1527 !) ; Kadra (Talbot !) ; Sumpkhund (Hallberg and McCann A308 !) ; Sirsi to Siddhapur (Hallberg and McCann A311 !) ; Devimani (Talbot !).

Distribution : W. Peninsula, Ceylon.

Where this species is growing together with other species of *Dimeria* it can easily be recognized by its overtowering the others.

4. Dimeria diandra, Stapf in Bhide, New and revised spec. of Gram. from Bombay Jour. and Proc. As. Soc. Bengal, new s. vii, (1911), 515.—*Woodrowia diandra,* Stapf in Hook. Ic. Pl. (1896), t. 2447; Hook. f. in F. B. I. vii, 241; Cke. ii. 1012.

Description : Cke. l.c. except for the number and description of the glumes, this part of the diagnosis must read like this : Glumes 4 : Lower involucral glume more or less dorsally hairy, with ciliolate margins ; upper involucral glume with a densely ciliate keel ; lower floral glume obovate-oblong, hyaline, nerveless ; upper floral glume 2-lobed, with a geniculate awn about 12 mm. long from the sinus, column of awn 4 mm. long, spirally ciliate, brown, the upper part of the awn yellow, longer than the column.

Locality : Konkan : Vasco da Gama (Bhide !) ; Marmagoa (Talbot 2557 !)—*Deccan :* Khandala, open grass land (Saxton and Bhide !, McCann A317 !).—*S. M. Country :* Castle Rock (Bhide !).—*Kanara :* Kumberwada (Talbot 2261 !) ; Kadra (Talbot 2822 !) ; Devimani (Talbot 3547 !) ; Jog to Siddahapur, open grass land, rocky soil (Hallberg and McCann A314 !) ; Mirjan (Hallberg and McCann A315 !).

Distribution : W. Peninsula.

6. ISCHÆMUM, Linn. (Cke. ii, 957)

Species about 50.—All belonging to the Old World, except 3 found in tropical America.

Cooke, l. c. describes 12 species. Of these *Ischæmum angustifolium* has to go under *Pollinidium* and *Ischæmum laxum, sulcatum* and *spathiflorum* under *Schima.* Instead 3 species new to the Presidency will be added to the genus *Ischæmum,* viz. *I. impressum,* Hack., *I. conjugatum,* Roxb. and *I. timorense,* Kth.

In *Ischæmum* the racemes are geminate or digitate.

A. Margins of lower involucral glume of sessile spikelet inflexed or incurved from base to apex.
I. Leaves rounded at the base (slightly cordate in *I. molle*), sessile on the sheath.
1. Pedicel of upper spikelet less than 1/3 the length of the lower spikelet.
(*a*) Lower involucral glume of sessile spikelets with nodulose margins ... 1. *I. aristatum.*
(*b*) Lower involucral glume of sessile spikelets closely transversely ribbed ... 2. *I. rugosum.*
(*c*) Lower involucral glume of sessile spikelets dorsally villous all over, not transversely ridged nor with nodulose margins ... ... 3. *I. molle.*
2. Pedicel of upper spikelet 1/3 the length of the lower spikelet or more.
(*a*) Upper involucral glume of sessile spikelets 2-fid, 3-nerved ... ... 4. *I. diplopogon.*
(*b*) Upper involucral glume of sessile spikelets acuminate, 5-nerved ... ... 5. *I. pilosum.*
II. Leaves hastate or cordate at the base, often petioled.
1. Pedicel of upper spikelet not 1/3 of the lower spikelet.
(*a*) Leaves 7·5—13 cm. long ... ... 6. *I. semisagittatum.*
(*b*) Leaves 25—35 cm. long ... ... 7. *I. conjugatum.*
2. Pedicel of upper spikelets as long as the lower spikelet, or longer ... ... 8. *I. impressum.*

B. Margins of lower involucral glume of sessile spikelets broadly incurved below the middle.
I. Keel of upper involucral glume winged above the middle.
1. Sessile spikelets 3 mm. long ; callus large, glabrous ; awn 4 mm. long... ... 9. *I. Lisboæ.*
2. Sessile spikelets 5 mm. long ; callus short, bearded ; awn 12 mm. long ... 10. *I. ciliare.*
II. Keel of upper involucral glume not winged. 11. *I. timorens.*

1. **Ischæmum aristatum,** Linn. Sp. Pl. (1753), 1049 ; Cke. ii, 958 ; Ranga Achariyar, South Ind. Grass. (1921), 151.

Description : Cke. l. c.

This grass is a very variable one, so variable, indeed, that it is almost impossible to distinguish good varieties, in spite of Hackel's and Hook. f.'s efforts.

Locality : Khandesh : W. Khandesh (Blatter !).—*Konkan :* Bassein (McCann 4474 !) ; Sion Bombay (McCann 5233 !) ; Bhandup (McCann 9899 !) ; Parsik, railway line (McCann 9901 !) ; Matunga near Bombay (Woodrow 4). *Deccan :* Khandala, on rocks (McCann 9908 !); Lohagad, half way up (McCann 9906 !) ; Deolali (Blatter and Hallberg 4554 !) ; Igatpuri (Blatter and Hallberg 5169 !) ; Mahableshwar (Talbot 4534 !) ; Lonavla (Garade !) ; Panchgani (Blatter and Hallberg B1216 !) ; Pasarni Ghat (Blatter and Hallberg B1307 !).—*S. M. Country :* Devarayi (Sedgwick and Bell 4456 !) ; Castle Rock (Bhide !) ; Belgaum (Ritchie 812/2).

Distribution : India (also on higher hills), Ceylon, China, Malaya.

2. **Ischæmum rugosum,** Salisb. Ic. Stirp. Rar. (1791), 1, t. 1 ; Roxb. Fl. Ind. I, 320 ; Hack. Monogr. Androp. 206 ; Duthie Grass. N.W. Ind. 18, and Fodd. Grass. N. Ind. 31 ; F. B. I. VII, 127 ; Cke. ii, 959 ; Ranga Achariyar, South Ind. Grass. (1921), 153 ; Haines Bot. Bihar and Orissa pt. V (1925), 1021.

Locality : Konkan : Bombay Island (Blatter !) ; Kankeshwar Hills, Alibag (Bhide !) ; Bassein (McCann 4479 !).—*Deccan :* Khandala, common, Echo-Point in a dry pool (McCann 9903 !) ; Igatpuri, common (McCann 4348 !) ! Poona (Woodrow).—*Kanara :* Halyal (Talbot 2140 !).

Distribution : India, Ceylon, China, Malaya.

3. **Ischæmum molle,** Hook. f. in F.B.I. vii (1896), 128 ; Cke. ii, 959.

Locality : Konkan : Sion creek (Sabnis 9900 !).—*Deccan :* Lonavla (Bhide ! Woodrow), Igatpuri (McCann 9543 !); Khandala, railway line (McCann 9944!).

Distribution : W. Peninsula, Central Provinces.

4. **Ischæmum diplopogon,** Hook. f. in F.B.I. vii (1896), 129 ; Cke. ii, 960.

Locality : Konkan : Matheran (Woodrow).—*Deccan :* Mahableshwar (Woodrow 4) : Mahableshwar, wet rocks in a stream (Sedgwick and Bell 4595 !] ; Amberwadi, Nasik District (Patwardhan !) ; Sakar Pathar, Lonavla (Gammie 15963 !) ; Khandala (McCann !) ; Bhorkas near Poona (Woodrow 3 !).

Distribution : W. Peninsula.

5. **Ischæmum pilosum,** Hack. Monogr. Androp. 240 ; Duthie Fodd. Grass N. India 31 ; Cke. ii, 961.

Vern. Names : Khavo (Broach), Kunda (Poona), Nuth, Kanigyanhullu (Bijapur).

Locality : Gujarat : Surat, roadside (Sedgwick !).—*Khandesh :* (Lisboa) ; Amalner (Blatter and Hallberg 4397 !).—*Deccan :* Ganeshkhind Bot. Gard. Kirkee (Gammie !) ; Mangri, 8 miles E. of Poona (Herb. Econ. Bot. Poona !) ; Yerowda (Herb. Econ. Bot. Poona !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Kirkee (Talbot !) ; Poona (Bhide !) ; Sholapur (Lisboa) ; Satara (Lisboa).—*S. M. Country :* Kunemelihalli (Sedgwick 2138 !) ; Dharwar (Sedgwick and Bell 5341 !) ; black soil field, Haveri (Talbot 2185 !) ; Gadag (Talbot 2185 !) ; black soil field, 7 miles S. of Hubli (Sedgwick 5341 !).

Distribution : W. Peninsula, Central Provinces, Rajputana.

6. **Ischæmum semisagittatum,** Roxb. Hort. Beng. (1814), 8 ; Hack. Monogr. Androp. 208 : Cke. ii, 961.

Locality : Khandesh : W. Khandesh (McCann !).—*Konkan :* Kenery Caves (McCann 9,914 !) ; Sion, Bombay (McCann 5,251 !) ; Bassein (McCann 4482 !) ; Sewri, Bombay (McCann 3586 !) ; Marmagoa (Talbot 2560 !) ; Parel, Bombay (Woodrow) ; Thana (Lisboa).—*Deccan :* Mahableshwar, in forests (Sedgwick and Bell 4802 !) ; Lonavla (Bhide ! Woodrow) ; Khandala, very common (McCann 9613 !) ; Igatpuri, very common (McCann 4319 !) ; Satara (Lisboa).—*S. M. Country :* Castle Rock (Bhide !); Dudsagar Falls (McCann !).—*Kanara:* Anmod (Sedgwick 3273 !) ; Supa (Talbot 2092 !) ; Jugglepet (Talbot 2089 !) ; Yellapur (Talbot, 738). A very common grass growing usually in the shade of trees. It is common throughout the S. part of the Presidency.

Distribution : Bengal, W. Peninsula, Ceylon.

Var. **dasyantha,** Hack. Monogr. Androp. (1889). 209 ; Cke. ii, 962.

Locality : Konkan (Stocks ex. Cke.).—*Kanara* (Woodrow !)

7. **Ischæmum conjugatum,** Roxb. Fl. Ind. i, 321 (not of Roxb. Hort. Beng. (1894), 8) ; Hack. Monogr. Androp. 205 ; F. B. I. vii, 131. *Spodiopogon conjugatus*, Voigt. Hort. Suburb. Calc. 706 —*Andropogon cordatifolius*, Steud. Syn. Gram. 376.

Description : An annual. Stem spreading from the root and creeping, then geniculately ascending, 30–35 cm. high, slender, stiff, purplish, repeatedly branching upwards. Leaves short, 25–35 mm. long, base hastate or broadly, deeply cordate, acuminate, broadest at the base, rather rigid, striate, lower petioled ; sheath of the upper ventricose and often open ; ligule short, glabrous. Spikes 2, short, 25–35 mm. long, sessile, villous ; joints very short, quadrately clavate, plano-convex, ciliate. Sessile spikelets 3 mm. long, pale. Glumes 4. Lower involucral glume oblong, obtuse, flat, 2-toothed, villous from below or above the middle to nearly the top, margins narrowly inflexed, not winged, upper half often greener, even or lower margins obscurely nodose. Upper involucral glume lanceolate, acuminate, strongly keeled, puberulous. Lower floral glume paleate. Upper floral glume cleft to about the middle, awn dorsally inserted at or below the cleft, slender, about twice as long as the spikelet. Pedicelled spikelets subsessile, almost awnless. Lower involucral glume as in the sessile.

Locality : Konkan : Okda Forest (Ryan, 712 !). *Deccan :* Mahableshwar to Pratabgad (Bhide !) ; Khandala (Garade !) ; College Farm, Poona (Pawar !).—*Kanara :* Gersoppa Falls (Chibber !).

Distribution : Bengal, W. Peninsula, naturalized in Ceylon.

8. **Ischæmum impressum,** Hack. Monogr. Androp. 210 ; F.B.I. vii, 132.

Stem 10–20 cm. high, slender, prostrate below, branching upwards, quite glabrous. Leaves 5–8 cm. long, upper 18 mm. broad, ovate or oblong-lanceolate, cordate, lower narrower, petioled, sparsely hairy beneath, margin thickened, scaberulous, sometimes crenulate ; sheath compressed, glabrous ; ligule oblong. Spikes 2, yellow ; joints and pedicels stout, clavate, ciliate with rigid hairs, forked at the top. Sessile spikelets 6–8 mm. long, shining ; callus short, broad, bearded. Lower involucral glume linear-oblong, flat, dorsally broadly irregularly depressed with shallow subsemilunar pits in the lower 2/3, above it winged and 2-cuspidate, narrowed and margins subnodulose at the base, wings erose. Upper involucral glume obtuse, chartaceous, ciliate, dorsally rounded with a median gibbosity and an auricle-like wing above it. Lower floral glume oblong-lanceolate, hyaline, 3-nerved, ciliate. Upper floral glume much shorter, glabrous, cleft to above the middle, awn short, geniculately inserted at the cleft. Pedicelled spikelets smaller than the sessile. Lower involucral glume obtuse, glabrous, many-nerved, winged on one margin. Upper involucral glume 7-nerved. Upper floral glume mucronate.

Locality : Deccan : Mahableshwar (Sedgwick and Bell, 4514 !); Panchgani, Tableland (Blatter, 5083 !, B1221 !, B1285 !) ; Igatpuri (Blatter !) ; Khandala, Echo-Point (McCann 9943 !) ; Lonavla (Bhide !).

Distribution : We have found this species only in the W. Ghats. Hooker f. mentions the Konkan, but with a sign of interrogation. As we have never met it in the Konkan, it is not likely to occur in that region. Where Huegel's specimen comes from we cannot say, and will in all probability never be known. We think it is quite safe to say that *I. impressum* is endemic in the W. Ghats of the Bombay Presidency.

9. **Ischæmum Lisboæ,** Hook. f. in F.B.I. vii, (1896), 133 ; Cke. ii, 962.

Locality : Kanara : N. Kanara (Lisboa) ; Karwar (Talbot 2209 !, McCann!). A rare grass, apparently endemic in N. Kanara.

10. **Ischæmum ciliare,** Retz. Obs. 6 (1791), 36 ; Hack. Monogr. Androp. 225 ; Duthie Fodd. Grass. N. India. 30 ; Cke. ii, 962. *I. geniculatum*, Roxb. Fl. Ind. I, 322. *S. obliquivalvis*, Nees in Nov. Act. Cur. XIX, Suppl. I (1843), 185 ; Duthie Grass. N. W. Ind. 16.

Locality : Konkan : Bassein (Ryan 445 !) ; St. Xavier's College Comp., Bombay (McCann 4594 !) ; Parel, Bombay (Woodrow) ; Compoli (McCann

9415 !) ; Alibag, sandy shore (Ezekiel !) ; Uran (McCann 5126 !) ; Salsette (Jacquemont 710).—*Deccan:* Khandala, very common (McCann 9612 !); Ganeshkhind Bot. Gard. (Herb. Econ. Bot. Poona !) ; Igatpuri (Blatter and Hall. 3927A !).—*S. M. Country :* Mugad, hill-side (Sedgwick 1823 !) ; Castle Rock (Bhide !).—*N. Kanara :* Yellapore (Talbot 1526 !) ; Halyal, borders of rice fields (Talbot 2141 !)! Ankola (Mamlatdar of Ankola !) ; Karwar, sea coast, sandy soil near Gaol (Talbot 2821 !) ; Gersoppa Falls (McCann !) ; Common throughout Kanara (McCann !) ; Kakti (Woodrow).

Distribution : India, Ceylon, China, Malaya, Australia.

11. **Ischæmum timorense,** Kunth Revis. Gram. i, 369, t. 98 ; Hack. Monogr. Androp. 229 ; F. B. I. vii, 136 :—*I. tenellum,* Roxb. Fl. Ind. i, 323.

Stem 15–45 cm. high, slender, branched, straggling, nodes glabrous, or sparingly bearded. Leaves 2·5–10 cm. long, sessile and petioled, linear-lanceolate, acuminate, glabrous or sparsely hairy, base of upper rounded, of lower rounded ; sheath lax, mouth hairy ; ligule obscure. Spikes 2–3, 25–50 mm. long, rather slender, sparingly villous ; joints and pedicels about half as long as the spikelets, nearly equal, shortly ciliate. Sessile spikelets 2·5–3 mm. long, greenish or with green nerves ; callus narrow, long-bearded. Lower involucral glume ovate or ovate-lanceolate, acuminate, bicuspidate, 5–9-nerved, base ventricose, margins broadly involute below, subauricled, dorsally convex, polished, nerves strong. Upper involucral bracts longer, acuminate or aristulate, dorsally rounded, recurved, 3–5-nerved, tip 2-toothed, dorsally usually ciliate. Lower floral glume lanceolate, falcate, palea linear-oblong. Upper floral glume short, 2-lobed, glabrous, awn in the cleft very slender, shortly exserted. Pedicelled spikelets like the sessile awned.

Locality: Sind: Sukkur (Mamlatdar of Sukkur !).—*Deccan:* Mahableshwar, common (Sedgwick and Bell 4503 !) ; Lonavla (Bhide !) ; Khandala, behind the Saddle (McCann 9915 !).—*S. M. Country :* Deciduous forests W. of Dharwar (Sedgwick and Bell 4500 !) ; Devikop (Sedgwick 2170 !) ; S. W. of Dharwar (Sedgwick and Bell 4429 !) ; Londa (Bhide !).—*Kanara :* Suppa (Talbot 2101 !) ; Yellapore (Talbot 2327 !) ; Dandeli (Talbot 2494 !).

Distribution : Burma, Chittagong, Bengal, Central Provinces, Sind, W. Peninsula, Ceylon, Malaya, Pacific Islands.

7. Thelepogon, Roth. (Cke. ii, 971).

Species 1.—India and tropical Africa.

1. **Thelepogon elegans,** Roth. ex Roem. and Schult. Syst. ii, 788 ; Nov. Pl. Sp. 62 ; Hack. Monogr. Androp. 267 ; F. B. I. vii, 148 ; Cke. ii, 671.—*Andropogon princeps,* A. Rich. Tent. Fl. Abyss. ii, 470, *t.* 102.—*Rhiniachne princeps,* Hochst. ex Steud. Syn. Pl. Glum. i, 360.—*Jardinea abyssinica,* Steud. l.c.—*Rhytachne princeps,* Durand and Schinz. Consp. Fl. Afr. v, 700.

Vern. Names : Bodga (Kaira), Bhatad (Thana), Bangadi (Poona), Pharoda (Ahmednagar).

Description : Cke. l.c.

Locality : Gujarat : Ahmedabad (Sedgwick !) ; Kaira (ex Burns).—*Konkan:* Matheran (D'Almeida A257 !) ; Thana (ex Burns).—*Deccan :* Najar to Pasur Rd. (Paranjpe !) ; Lina Hill, Nasik District (Blatter and Hallberg A79 !, 4544 !) ; Katraj Ghat (Gammie !) ; Bairawadi, Purandhar (McCann 5053 !) ; Panchgani (Blatter and Hall. B1267 !) ; Poona (Woodrow) ; Hewra (Dalzell) ; near Nasik (Edgeworth) ; Ahmednagar (ex Burns).—*S. M. Country :* Dharwar (Sedgwick 1824 !) ; Alnawar (Talbot 2303 !) ; Belgaum (Ritchie 812).—*Kanara :* Halyal (Talbot 2094 !, 2142 !).

Distribution : Central India, W. Peninsula, Tropical Africa.

Uses : Eaten by horses, although very bitter (Dalzell).

8. Sehima, Forsk. Fl. Aegypt.

Arab. 178 ; Stapf. in Fl. Trop. Afr. ix, 35.

Annual or perennial grasses. Blades convolute when young, at length flat, narrow ; ligules a line of stiff hairs. Racemes usually gently curved, dorsiventrally and laterally compressed, with the pedicelled spikelets converging over the convex side, joints and pedicels sublinear and parallel. Sessile and pedicelled spikelets heteromorphous. Spikelets 2-nate, those of each pair differing in sex, one sessile, the other pedicelled on the articulate fragile rhachis of solitary spike-like racemes, the pedicelled tardily separating from their pedicels, the sessile deciduous together with the adjacent joint of the rhachis and the pedicel. Florets 2 ; lower male, upper bisexual in the sessile, male or neuter in the pedicelled spikelets. Sessile spikelets : glumes equal or subequal ; lower grooved, rarely flat, 2-dentate or 2-mucronate, more or less chartaceous, upwards acutely 2-keeled with inflexed margins, keels winged ; upper glume boat-shaped, keeled upwards with a bristle-like awn. Valves hyaline, of lower floret entire, muticous, of upper 2-fid and awned from the sinus. Valvules more or less equalling their valves, hyaline. Lodicules 2, cuneate. Stamens 3. Stigmas linear-oblong, laterally exserted. Grain oblong, obtusely trigonous ; embryo reaching to the middle of the grain. Pedicelled spikelets flat, with 2 florets resembling the lower floret of the sessile spikelets, the lower or both more or less reduced and barren.

Species about 5.—India, Tropical Africa, N. America.

A. Racemes enclosed in long narrow spathes ... 1. *S. spathiflorum.*
B. Racemes not enclosed in spathes—
  I. Sessile spikelets 6-7 mm. long. Lower involucral glume of sessile spikelet 6-nerved ... 2. *S nervosum.*
  II. Sessile spikelets 7-11 mm long. Lower involucral glume of sessile spikelet 3-5-nerved ... 3. *S. ischæmoides.*
  III. Sessile spikelet 9 mm. long. Lower involucral glume of sessile spikelet 2-nerved ... ... 4. *S. sulcatum.*

1. **Sehima spathiflorum,** nov. comb. Blatter and McCann.—*Ischæmum spathiflorum,* Hook. f. in F. B. I., vii (1896), 138 ; Cke. ii, 963.

Description : Cke. l. c.

Locality : Khandesh : Toranmal (McCann 9922 !).—*Konkan :* Penn (Bhide !) ; Matheran (Paranjpe !) ; Bassein (Ryan 2300 !) ; Kenery Caves (McCann 9920 !) ; Island of Salsette in hilly stony places (Jacquemont 797).—*Deccan :* Lonavla (Bhide !) ; Khandala (Woodrow) ; Khandala, in watercourses, very common (McCann 9928 !) ; Palasdari on the Bhor Ghat, G. I. P. Railway (Woodrow) ; Lohagad, plain (McCann 9919 !) ; Bairawadi, Purandhar (McCann 5054 !) ; Igatpuri (Blatter and Hallberg 3836 !, McCann !).

Distribution : Endemic.

2. **Sehima nervosum,** Stapf. in Fl. Trop. Afr. IX, 36 ; Haines pt. v, 1023.—*S. macrostachyum,* Hochst. in Schimp. Pl. Abyss. n. 1705.—*Andropogon nervosus,* Rottl. *apud* Willd. in Verh. Naturf. Fr. Berlin, iv (1803), 218.—*Andropogon striatus,* Klein *apud* Willd. Sp. Pl. iv. (1805), 903 ; R. Br. Prodr. 201.—*A. tacazensis,* Steud. Syn. Pl. Glum. i, 369.—*A. macrostachys,* Anders. in Schweinf. Beitr. Fl. Aeth. 306 (*per errorem* 310).—*Ischæmum laxum,* R. Br. Prodr. 205 ; Hook. f. in F. B. I. vii, 136, *partim ;* Cke. ii, 964, *partim.*—*Ischæmum laxum* var. *genuinum,* Hack. in Monogr. Androp. 245.—*Ischæmum nervosum,* Thw. Enum. Pl. Zeyl. 305.—*Ischæmum macrostachyum,* A. Rich. Tent. Fl. Abyss. ii, 472.—*Pollinia striata,* Spreng. Pug. ii, 12.—*Hologamium nervosum,* Nees in Edinb. N. Phil. Journ. xviii, 185.

Description : A perennial, densely tufted grass. Stems erect, 60 cm. to 1 m. high, on a short rootstock, simple or nearly so, slender, terete, about 4-noded, middle and upper internodes exserted, smooth or slightly rough below the inflorescence, glabrous. Leaves 15-30 cm. and longer, 2-4 mm. broad, erect, linear, narrowed into long capillary tips, flat, smooth, striate, glaucous, more or less scabrid, lateral nerves about 3 on each side, like the midrib whitish and prominent on both sides ; sheaths shorter than the internodes, tight, terete, striate, smooth or nearly so, glabrous or sparingly hirsute from tubercle-based hairs ; ligule a line of short stiff hairs. Racemes solitary, 5-10 cm. long, erect, slightly curved, pale, fragile ; joints and pedicels parallel, sublinear, slightly compressed, 3-4·5 mm. long, densely ciliate with white hairs along the angles, otherwise glabrous, tips more or less oblique. Sessile spikelets lanceolate-linear to linear, acuminate, 6·25-7 mm. long, pale green, with a shortly bearded callus. Glumes subequal : lower subchartaceous to chartaceous, with an unequally 2-toothed, flat and membranous beak, the teeth of which sometimes run out into ciliate mucros, deeply grooved, especially below the middle, acutely 2-keeled, outer keel generally winged upwards, intracarinal nerves 4, with transverse veins in the upper part, like these green and raised on a white ground ; upper glume subchartaceous, slightly shorter, boat-shaped, sublinear in profile, keeled above, with the keel widened at the apex and passing into a fine bristle 11–12·5 mm. long, 5-nerved with fine transverse veins, ciliate. Lower floret : valve faintly 2-nerved, hyaline, ciliate, 4·5 mm. long, with a narrow, linear valvule of about equal length and a male flower. Upper floret bisexual : valve oblong-lanceolate, 4 mm. long, 2-fid, with narrow lobes, hyaline, 3-nerved, ciliate ; awn up to 43 mm. long, slender, column spirally twisted, bronze colour, very minutely ciliate along the spiral, bristle whitish, as long as the column or slightly longer ; valvule as long as the valve, linear, subacute, 2-nerved, ciliate. Anthers 3 mm. long. Styles and stigmas pale, 2 mm. long. Pedicelled spikelet lanceolate, acuminate, green or tinged with purple, 7–8·5 mm. long, glabrous ; lower glume slightly 2-toothed, long-ciliate from the hairs of the tightly inflexed margin, keels very narrowly or obscurely winged, wing rigidly ciliate, intracarinal nerves 5, the inner 3 very prominent and rough ; upper glume lanceolate, long and finely acuminate, hyaline, ciliate, 3-nerved ; lower floret as in the sessile spikelet ; upper floret very much like the lower. Stamens smaller in the lower floret or both florets reduced and empty.

Locality : Gujarat : Porbandar (Bhide !) ; Junagad, Kathiawar (Blatter 3799 !) ; Surat, city walls (Herb. St. X. C. 9498 !) ; Ahmedabad (Sedgwick !).—*Khandesh :* (Lisboa) ; Umalla village, on Tapti river (Blatter and Hallberg 5160 !) ; Toranmal, common on the slopes (McCann 9916 !).—*Deccan :* Purandhar Fort (Bhide !, McCann 5106 !) ; Khandala, St. X. Villa compound (McCann 9419 !) ; Deolali (Blatter and Hallberg 4548 !) ; Lonavla (Bhide !) ; Panchgani (Blatter and Hallberg B1269 !) ; Poona (Woodrow) ; Poona to Karli (Jacquemont 530).—*S. M. Country :* Dharwar (Bhide !) ; Haveri (Talbot 2186 !).

Distribution : Bengal, Behar, Central Provinces, Rajputana, W. Peninsula, Ceylon, Tropical Australia, Somaliland, Abyssinia, Eritrea. Cape de Verd Islands

Uses : Used for thatching in Khandesh (Lisboa). Considered to be one of the best fodder grasses and is eaten by cattle even after the fall of the spikes (Haines).

3. **Sehima ischæmoides,** Forsk. Fl. Aegypt.—Arab. 178 ; Stapf in Fl. Trop. Afr. IX, 37.—*Sehima Kotschyi*, Hochst. in Flora (1844), 247.—*Ischæmum Sehima*, R. Br. Prodr. I, 204.—*Ischæmum inscalptum*, Hochst. in Schimp. Pl. Abyss. n. 739 and Flora (1844), 247 ; A. Rich. Tent. Fl. Abyss. II, 472.—*Andropogon Sehima*, Steud. Syn. Pl. Glum. I, 369.—*Andropogon lineatus*, Steud. l.c.—*Andropogon schangulensis*, Rupr. ex. Steud. l.c.—*Andropogon inscalptus*, Anders. in Schweinf. Beitr. Fl. Aeth. 306 (*per errorem* 310).—*Ischæmum laxum*, R. Br. Prodr. (1810), 205 ; Hook. f. in F.B.I., VII, 136, *partim.*—*Ischæmum laxum* var. *inscalptum*, Hack. in Monogr. Androp. 245.—*Andropogon rhynchophorus*, Stapf in Bull. Soc. Bot. Fr. LV (1908) Mem. VIII. 101.

An annual herb. Stems usually in small fascicles, rarely over 45 cm. high, slender, terete, simple, 2- or 3-noded, middle and upper internodes slightly exserted, smooth, glabrous. Leaves glaucous, linear, tapering to a long fine point, up to 13 cm. long, 1·5–3·1 mm. broad, more or less scabrid, midrib fine like the 1 or 2 primary lateral nerves. Racemes solitary, or sometimes an additional 1 or 2 from the upper nodes, 2·5–7·5 cm. long, erect, or slightly nodding ; joints and pedicels parallel, sublinear, slightly compressed, 3·1 mm. long, very densely ciliate from white hairs along the angles, otherwise glabrous, tips more or less oblique. Sessile spikelets linear 7–11 mm. long, pale green, with a shortly bearded callus ; lower glume subchartaceous to chartaceous, with an unequally 2 toothed flat and membranous long beak, the teeth of which run out into mucros, deeply grooved, especially below the middle, acutely 2-keeled, the outer keel generally winged upwards, intracarinal nerves 3–5, raised, rough, only distinct just above the groove ; upper glume and florets as in *Sehima nervosum*, excepting the bristle of the glume which is over 15·5 mm. long and the awn, the column of which is generally more brown than bronze in colour and has much longer cilia along the spirals. Pedicelled spikelets narrowly lanceolate, long-acuminate, pale green, up to 12·5 mm. long, glabrous ; lower glume with two long setaceous teeth, sparingly hairy on the back, otherwise the spikelet as in *Sehima nervosum.*

Locality : Deccan (Woodrow 147, Law, ex. Stapf.)

Distribution : Tropical Arabia, Yemen, Abyssinia, Sudan, Kordofan, Nubia, Cameroons, Cape de Verd Islands.

4. **Sehima sulcatum,** comb. nov. Blatter and McCann.—*Ischæmum sulcatum*, Hack. in Monogr. Androp. 248 ; Hook. f. in F.B.I., vii, 137 ; Cke. ii, 964.
Description : See Cke. l.c.
Locality : Deccan : Satara (Lisboa) ; Malsiras, Sholapur Taluka (Lisboa).—*S. M. Country :* Black soil banks 35 miles S. of Dharwar (Sedgwick 3745 !) ; banks of black soil fields 7 miles S. of Hubli (Sedgwick and Bell 5342 !) ; Dharwar, common (Sedgwick 1819 !, McCann !).
Distribution : Central Provinces, W. Peninsula.

9. POLLINIDIUM, Stapf.

As far as we can make out the diagnosis of this genus was published for the first time in Haines' Botany of Bihar and Orissa, pt. 5 (1924), 1020.

Densely tufted, perennial herbs with woolly rootstock and basal sheaths. Leaves convolute when old, wiry, mouth of sheaths ciliate. Spikes digitate or fascicled, fascicles with filiform peduncles on a more or less branched panicle. Spikelets 2-nate, sessile and pedicelled, similar, on the articulate, fragile, compressed, not stout rhachis. Callus densely clothed with long brown hairs. Glumes 4 : Lower involucral glume flattened, 2-3-dentate, dorsally hairy at base, 5–7-nerved, margins inflexed ; upper involucral glume cymbiform, minutely cuspidate, 3–5-nerved, with a slender awn. Lower floral glume hyaline, sparsely ciliate, elliptic, palea finely ciliate ; upper floral glume narrow, conduplicate, entire or 2-toothed shortly awned from the tip or minute sinus, palea broad and nearly as long as the glume, densely ciliate on the top.

1. **Pollinidium angustifolium,** Haines Bot. Bihar and Orissa, pt. 5 (1924), 1020.—*Ischæmum angustifolium*, Hack in Monogr. Androp. 241 ; Hook. f. in F B.I. vii, 129 ; Cke. ii, 960.—*Spodiopogon angustifolius*, Trin. in Mem. Acad. Petersb., ser. VI, ii (1833), 300 ; Spec. Gram. Ic. t. 336.—*Pollinia eriopoda*, Hance in Journ. Bot. iv (1866), 173.– *Andropogon binatus*, Retz. Obs, vi, 21.
Description : Cke. l.c.
Locality : Gujarat : Rajkot (Woodrow).—*Konkan :* Victoria Gardens, Bombay (McCann 4302 !).—*Deccan :* College Garden, Poona (Grade !) ; cultivated at Poona (Woodrow).
Distribution : Afghanistan, India, China, Philippines.
Uses : In Bihar and Orissa the Sabai grass is used for strings, ropes and mats (the Baib matting of Calcutta) and is very largely employed for paper-making. Fires improve the crop by removing shade. It is easily grown by division of the rootstock or from seed. From seed it yields a crop in about three years. Cattle do not eat it (Haines). For Bombay see Cke. l.c.

10. APOCOPIS, Nees. (Cke. ii, 967)

1. **Apocopis vaginatus,** Hack. in Oestr. Bot. Zeitschr. 41 (1891), 8 ; Cke. ii, 967.—*A. Wightii*, Nees, var. *vaginata*, Hook. f. in F.B.I., vii, 143.
Description : Cke l.c.
Locality : Gujarat : Ahmedabad, field (Sedgwick !).—*Konkan :* Kalyan (Woodrow).—*S. M. Country :* Forests W. of Dharwar (Sedgwick !)—*Kanara :* Halyal (Talbot 2379 !) ; N. Kanara (Woodrow).
Distribution : Bihar, Central India, Deccan and W. Peninsula, Burma, Ceylon.

11. LOPHOPOGON, Hack.

1. **Lophopogon tridentatus,** Hack. in Engl. and Prantl. Nat. Pflanzenf. ii, pt. ii (1887), 22, 56, Monogr. Androp. 254, t. i. f. 14 ; Hook. f. in F.B.I. vii, 149 ; Cke. ii, 966.—*Andropogon tridentatus*, Roxb. Fl. Ind. i, 257.—*Saccharum tridentatum*, Spreng. Syst. i, 283.
Description : Cke. l. c.
Locality : Khandesh : Tapti, Bhusawal (Blatter and Hallberg 5457 !).—*Deccan :* Agricultural College compound, Kirkee (Bhide !) : Bapodi near Poona (Gammie 15315 !) ; Bowadhar near Poona (Garade !) ; Rahuri (Nana A80 !) ; Igatpuri (McCann 4572 !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Deolali (Blatter 9620 !, 9610 !) ; Jeur, Sholapur Dist. (Woodrow !).—*S. M Country :* Dharwar, on dry gravelly uplands 2,400 ft., rain 34 inches (Sedgwick 3010 !).
Distribution · Central Provinces, W. Peninsula.

12. APLUDA, Linn. (Cke. ii, 956)

1. **Apluda varia,** Hack. in Monogr. Androp. 196, var. **aristata,** Hack. l. c. 199 ; Hook. f. in F.B.I., vii, 150 ; Cke. ii, 956, *comprehendens etiam alias varietates* ; Stapf. in Fl. Trop. Afr. ix, 40 ; Haines pt. v, 1057.—*Apluda aristata*, Linn. Cent. ii, 71 ; Schreber Beschr. d. Gr. 93, t. 42 ; Beauv. Agrost 133 ; Duthie Fodd. Grass. of N. Ind. 44, t. 29.—*Apluda Gryllus*, Beauv. Agrost. Explic. planches, 15, t. 23, fig. 5 (6 *per errorem*).

As our Bombay specimens must be referred to the var. *aristata* and as Cooke's description comprises also other varieties we give in the following Stapf's diagnosis of the variety *aristata*. This must not prevent botanists from paying attention to the possible occurrence of other varieties in the Presidency.

Description : Mostly annual, branched from the base. Stems densely tufted, erect, 30–180 cm. high, or geniculately ascending and often rooting from the nodes, many-noded, terete, smooth and polished. Leaves 10–45 cm. by 4–15 mm., linear-lanceolate, long-attenuated towards the base, almost petioled, tapering upwards to a fine setaceous point, convolute in bud, then flat, somewhat rigid or flaccid, glaucous below, glabrous or very rarely sparingly hairy, slightly rough above, scabrid along the margins, midrib white above, stouter towards the base, primary lateral nerves, 5–8 on each side, fine ; sheaths terete, tight and glabrous or very rarely sparingly hairy, those supporting the flowering branches wider and shorter with reduced blades ; ligules short, rounded off, glabrous or ciliate. Panicle upto 60 cm. long, much compound, primary branches long, those of the following orders gradually shorter, bearing clusters of trios of spikelets ; spathe at the base of the trios ovate to ovate-oblong, mucronate or bearing rudimentary blades, glabrous, green or tinged with purple, 4–4·5 mm. long ; bulbous basal joint up to 1·5 mm. long, whitish. Sessile spikelets lanceolate-oblong, acute, up to 4·5 mm. long. Lower involucral glume chartaceous, firmer below, many-nerved ; upper involucral glume somewhat gibbous on the back, scaberulous on the keel. Lower floret : Valve oblong-lanceolate, acute, slightly shorter than the glumes, 3-nerved, glabrous ; valvule linear-lanceolate, almost as long as the valve, 2-nerved. Upper floret : valve 3·1 mm. long, 2-fid to beyond the middle, awn up to 9·3 mm. long, very fine, with or without a distinct twisted column ; valvule generally much shorter, oblong or broad-ovate, nerveless. Anthers 2·3–3·1 mm. long. Stigmas purple, up to 4·5 mm. long. Grain about 1 mm. long, Pedicels 2·3–3·1 mm. long, sparingly ciliate. Lateral pedicelled spikelet 4–5 mm. long. Glumes similar, subherbaceous, lanceolate, acute, many-nerved ; lower glume rather flat on the back, upper not or obscurely keeled and not gibbous. Florets as in the sessile spikelet but the upper not awned, both are male more or less reduced. Terminal spikelet reduced to a short striate glume, continuing the pedicel.

Locality : Gujarat : Broach (Chibber !) ; Nadiad Farm (Herb. Econ. Bot. Poona !) ; Surat (Gammie 16467 !, Cooke) ; Karu Roa, Cutch (Blatter 3776 !) ; Kala Pacham Island (Blatter 3735 !) ; Garvi Dangs (Sedgwick !) ; Ahmedabad (Cooke).—*Khandesh :* Muravat, Tapti bank (Blatter and Hallberg 4434 !) ; N. slope of Chanseli Hill (McCann A83 !) ; Toranmal (McCann A84 !) ; Munmad, Ankai Hill (Blatter A146 !).—*Konkan :* Dhapli forest (Roan !) ; extremely common throughout the islands of Bombay and Salsette (McCann !) ; Bassein (McCann 4480 !) ; Alibag, margin of water-works (Ezekiel !).—*Deccan :* Purandhar (McCann 5008 !, Bhide !); Khandala, very common (McCann 5294 !) ; Diva Ghat (McCann A86 !); Sholapur (D'Almeida A87 !); Igatpuri, very common (McCann 4325 !, 4324 !); Panchgani (Blatter 53–85 !, Bhide !, Blatter and Hallberg B1322 !).—*S. M. Country :* Dharwar (Sedgwick and Bell 4489, 2400 ft., rain 34 inches ; Londa (Gammie 15851 !); Belgaum (Ritchie 824).—*Kanara :* Halyal (Talbot 2495 !); Juggleput (Talbot !); Kawarwad (Talbot 2246 !).

Distribution : Socotra, India, Ceylon, E. Tropical Asia, Malaya, Australia, Pacific Islands.

Uses : A fairly good fodder grass, and readily eaten by cattle when young (Duthie).

13. HEMARTHRIA R. Br. (Stapf in Fl. Trop. Afr. ix, 54)

Decumbent or ascending perennial grasses with branched, many-noded stems. Leaves linear, conduplicate in bud, then flat. Ligules very short, membranous.

Racemes compressed, often curved, tips more or less subulate from the slender terminal spikelet ; rhachis not or tardily breaking up. Spikelets pseudo-opposite owing to the fusion of joints and pedicels, each pair made up of a sessile (secondary) spikelet and the pedicelled companion of the sessile spikelet of the next lower node. Spikelets two-nate on the tough or tardily disarticulating rhachis of spike-like, spathe-supported racemes which terminate the culms and their often fascicled branches, alike in sex and shape, or at least similar ; joints and pedicels fused into roughly semicylindric internodes, hollowed out on the inner face for the reception of the sessile spikelet ; disarticulation at a right angle to the rhachis or slightly oblique, tips of joints truncate, not hollowed out or appendaged. Sessile spikelet : Florets 2, lower reduced to a barren valve, upper bisexual, awnless. Glumes equal or subequal, lower flat on the back, 2-keeled, very narrowly inflexed along the margins, coriaceous or subcoriaceous, closing up the cavity formed by the adjacent joint and pedicel, upper membranous, adhering to the inner face of the cavity. Valves hyaline, of lower floret 2-nerved, of upper usually nerveless. Valvule of upper floret hyaline, small, nerveless. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong, dorsally slightly compressed ; embryo about $\frac{1}{3}$ the length of the grain : hilum conspicuous, punctiform, subbasal. Pedicelled spikelet with more elongated acuminate glumes, especially the terminal, the upper glume mucronate or aristate.

Species about 8. Throughout the warm countries of the Old World, 1 also in America, but probably introduced.

1. **Hemarthria glabra**, comb. nov. Blatter and McCann. *Rottbœllia glabra*, Roxb. Fl. Ind. ed. Carey i, 353. *Hemarthria coromandelina*, Steud. Syn. i, 358. *Rottbœlia compressa*, Linn. f. Suppl. 114, var. *genuina*, Hack. Monogr. Androp. 286 ; Hook. f. in F. B. I. vii, 153. *Rottbœllia compressa*, Linn. f. Suppl. 114, *partim* ; Cke. ii, 952, *partim*. *Hemarthria compressa*, Kunth Enum. i, 465, *partim*.

A word of explanation is required regarding the new name. Haines in his Botany of Bihar and Orissa, pt. VI (1924), 1061, mentions a species under the name of *Hemarthria compressa*, R. Br. and gives as synonym *Rottbœllia compressa*, Linn. f. which, in our opinion, is not correct. *Hemarthria compressa*, R. Br. Prodr. Floræ Novæ Hollandiæ et insulæ Van Diemen, p. 207, represents only partly *Rottbœllia compressa*, Linn. f. Besides, Stapf in. Fl. Trop. Afr. ix, 55 has separated *Rottbœllia compressa*, Linn. f. var. *fasciculata* from the type and described it under the specific name *Hemarthria fasciculata*, Kunth Rev. Gram. i, 153. He was allowed to use this old name, because *Hemarthria fasciculata* is the same plant as Hackel's var. *fasciculata* (Monogr. Androp. 287.) As to the species under consideration, it coincides with Hackel's *Rottbœllia compressa* Linn. var. *genuina*. With this *Hemarthria compressa*, Kunth Enum. i, 465 agrees only partly and this name cannot, therefore, be adopted. There are only two names left which can be considered : *Rottbœllia glabra* and *Hemarthria coromandelina*. Of these the former is the older and should, therefore, be retained, but as the species is being transferred to the genus *Hemarthria*, the plant has to be called *Hemarthria glabra*, nob.

Description : A perennial grass. Stems creeping below, then erect, scandent, 1·5 to 6 m. long (Roxb.). Blade of leaf short, slowly getting narrower upwards, but at the apex slightly obtuse ; sheath at the nodes glabrous. Racemes slender, compressed, 6–10 cm. long, solitary or the upper ones often fascicled. Spikelets 2-nate, 4–4·5 mm. long ; callus 1 mm. long, obconical, obtuse, glabrous. Sessile spikelets : Lower involucral glume broad, ovate lanceolate, obtuse, at the apex emarginate or obtusely bidentate, not in the least acuminate, scarcely constricted below the apex. Pedicelled spikelets : Pedicel adnate. Glumes acute or subacuminate.

Locality : Sind : Bughar, Indus River (Blatter and McCann D661 !) ; Mirpur Sakro (Blatter and McCann D662 !). *Gujarat :* Kankaria Tank, Ahmedabad (Sedgwick !).—*Khandesh :* Tapti, Bhusawal N. E. (Blatter and Hallberg 5495 !).—*Kanara :* Sirsi to Siddhapur (Hallberg and McCann A78 !). We have not included the localities mentioned by Cke. ii, 952 as some of his specimens might belong to another species.

Distribution : We do not know of any definite record as to the distribution of this species. Hooker f. calls it common in India. Hackel gives Bengal, Sarampur, Punjab, Nepal, Ceylon, China. Duthie says it occurs in moist places in the plains, and at low elevations on the hills of N. India, and extends to Australia. It would apparently be correct to say that this plant is found all over India and Ceylon. We are not so sure about Australia.

The question now arises whether *Hemarthria fasciculata*, Kunth occurs in the Presidency. Wight, Roxburgh, Hook. f. and Duthie mention it for other parts of India and Duthie found it in the same localities where he gathered the previous species, but we have no reliable information at hand to say that it has been found in the Bombay Presidency. In all probability it does occur in our parts. In order to help botanists to clear up this point we add Stapf's description and synonymy of *H. fasciculata*, Kunth. At the same time it will be good to remember what Hackel says under *Rottbœllia compressa*, Linn. f. : '*Species valde polymorpha ; varietates sequentes in speciminibus typicis satis distinctæ, ed et ipsæ ita variabiles, ut nullus earum characterum constans, formæque intermediæ frequentes.*'

Hemarthria fasciculata Kunth Rev. Gram. i, 153, and Enum. i, 465 ; Hack. in Mart. Fl. Bras. II, iii, 314, t. 72, fig. 2.—*H. capensis*, Trin. Androp. in Mem. Acad. Petersb. 6 me sér. ii, 248.—*Rottbœllia compressa*, Linn. f. var. *fasciculata*. Hack. Monog. Androp. 286 ; Hook. f. in F.B.I. vii, 153 ; *Rottbœllia compressa*, Linn. f. ; Cke. ii, 952, *partim*.—*Rottbœllia fasciculata*, Lam. Illustr. i, 204.—*Lodicularia fasciculata*, Link. Hort. Berol. i, 6.—*Lodicularia capensis*, Nees Fl. Afr. Austr. 128.—*Lepturus fasciculata*, Trin. Fund. Agrost. 123.

Description : A perennial grass. Stems erect or more often ascending, sometimes from a long decumbent rooting base, usually branched, 30 cm. to 1·5 m. high, many-noded, compressed, glabrous. Leaves linear, gradually tapering, acute, very variable in length and width, up to 23 cm. by 4 mm ; sheaths shorter or the lower longer than the internodes, compressed, keeled, often ciliate towards the mouth, otherwise glabrous or almost so ; ligules membranous, very short, ciliate. Racemes usually fascicled, straight or curved, tapering to a slender point formed by the terminal spikelet, ultimately more or less fragile. Sessile spikelet linear-oblong to oblong, from a short obtriangular more or less conspicuous glabrous callus, 4–5·5 mm. long, glabrous. Lower glume coriaceous, opaque, usually more or less constricted below the obtuse entire or emarginate, 2-keeled and very narrowly winged tips, smooth, intracarinal nerves about 7 ; upper broadly oblong-lanceolate, acute, membranous except at the hardened tip, 3-nerved. Lower floret : Valve oblong, subobtuse, distinctly shorter than the glumes, 2-nerved. Upper floret : Valve slightly shorter, ovate-oblong, obtuse, nerveless. Anthers 1·5–2·3 mm. long. Stigmas about 1·5 mm. long, laterally exserted. Grain oblong, dorsally compressed, about 1·5 mm. long, reddish ; scutellum exceeding half the length of the grain ; hilum punctiform, subbasal. Pedicelled spikelet similar in sex and shape to the sessile, but slightly longer, with the lower glume more acuminate and acute, and the upper sharply mucronate, the mucro somewhat exceeding the lower glume.

Distribution : British E. Africa, Mozambique District, throughout Africa in the Mediterranean region (Stapf), India, America, probably introduced.

14. MANISURIS, Linn. f.

Species 1.—Throughout the tropics.

1. **Manisuris granularis**, Sw. Prodr. Veg. Ind. Occ. (1788), 25 ; Beauv. Agrost. t. xxi, Fig. 10 ; Roxb. Pl. Corom. ii, 11, t. 118 ; Mart. and Eichl. Fl. Bras. ii, 2, t. 46 ; Hack. Monogr. Androp. 314 ; Duthie Grass. N. W. Ind. 18, Fodd. Grass, N. India. 29, t. 46 ; Hook. f. F.B.I. vii, 159 ; Cke. ii, 955 ; Stapf Fl. Trop. Afr. ix, 57.— *M. polystachya*, Beauv. Fl. Owar. et. Ben. t. 14.—*Cenchrus granularis* Linn. Mant. ii, App. 575.—*Hackelochloa granularis*, O. Ktze. Rev. Gen. Pl. ii, 776.—*Rytilix granularis*, Skeels in U.S. Dept. Agr. Bur. Pl. Industr. Bull. 282 (1913), 20.

Locality : Gujarat : Charodi (Gammie 16534 !).—*Konkan :* Wada Taluka (Ryan 600 !) ; Mulgaum in Salsette, open grass land (McCann 3642 !).—*Deccan :* Poona (Woodrow ! Cooke) ; Deolali (Blatter and Hallberg 4552 !) ; Igatpuri (McCann 4573 !) ; Railway line, Kirkee to Poona (Garade 8231 !) ; Chattar(hinji Hill, Poona (Ezekiel !) ; Khandala (Woodrow), behind Hotel

(McCann 9410 !), behind Duke's Nose (McCann 9393 !).—*S. M. Country :* Dharwar (Sedgwick and Bell 4146 !, Woodrow), 2,400 ft., rain 34 in.; Kuput Hill, Dharwar District (Talbot 2323 !).—*Kanara :* Halyal (Talbot 1733 !, 2385 !).

15. PELTOPHORUS, Desv. (Stapf Fl. Trop. Afr. ix, 59)

Annual or perennial short grasses with slender, much-branched, rarely simple stems. Leaves linear, narrow, conduplicate in bud, then flat; ligules short, membranous. Racemes much compressed, rather slender, straight or curved, very conspicuously dorsiventral. Spikelets pseudo-opposite owing to the fusion of joints and pedicels, each pair made up of a sessile (secondary) spikelet and the pedicelled companion of the sessile spikelet of the next lower node. Spikelets 2-nate on the rhachis of spike-like, spathe-supported racemes which terminate the stems and their branches, different in sex and shape. Joints and pedicels fused into somewhat stout internodes, convex on the back, hollowed out on the inner face for the reception of the sessile spikelet; disarticulation at a right angle to the rhachis, tips of internodes truncate with two concavities corresponding to the next upper sessile and the adjacent pedicelled spikelet. Sessile spikelet dorsally much compressed. Florets 2, lower male or neuter and then with or without a valvule, upper bisexual, awnless. Glumes equal or the upper shorter; lower coriaceous, transversely rugose or muricate, conspicuously winged from the keels, upper membranous, immersed in the cavity formed by the joint and pedicel, usually 3-nerved, keeled, often indistincly. Valves hyaline, nerveless or 2-3-nerved. Valvule, if present, hyaline, nerveless or 2-nerved. Lodicules 2, cuneate. Stamens 3. Stigmas linear, laterally exserted low down. Grain oblong; embryo equalling the grain. Pedicelled spikelet male or neuter. Lower glume coriaceous, smooth, asymmetrically or unilaterally winged, upper variously winged from the keel. Florets as in the sessile spikelet but male or barren.

Species 5.—India (4) and Tropical Africa (1).

I. Lower involucral glume 2—aristate ... 1. *P. divergens.*
II. Lower involucral glume with a simple awn or acuminate.
  1. Lower involucral glume broadly ovate, acuminate (not awned) ... ... 2. *P. acuminatus.*
  2. Lower involucral glume lanceolate with a slender scabrid awn ... ... 3. *P. Talboti.*

1. **Peltophorus divergens,** comb. nov. Blatter and McCann.

Rottbœllia divergens, Hack. Monogr. Androp. 293; Lisboa in Jour. Bom. Nat. Hist. Soc., vi (1891), 195; Hook. f. in F. B. I., vii, 155; Cke. ii, 953.

Description : Cke. l. c.

Locality : Konkan : Trombay (McCann A71 !).—*Deccan :* Mahableshwar, 4,500 ft., rain 270 inches (Sedgwick and Bell 4560 !, Lisboa); Panchgani (Blatter and Hallberg B1252 !, B1259 !, B1263 !, B1286 !), behind the Tableland on rocks (Blatter 3805 !); Satara (Lisboa); Lonavla (Bhide !); Khandala (Woodrow), Saddle, very common all over (McCann 9616 !).—*S. M. Country :* Amboli Ghat (Talbot 4305 !); Belgaum (Ritchie 808, 827).—*Kanara :* Castle Rock, 1,800 ft., rain 300 inches (Sedgwick and Bell 4295 !), Karwar (Talbot 3171 !).—Usually growing on rocks in tufts.

Note. The spikes are very brittle when dry and always fall off.

Distribution : W. Peninsula.

2. **Peltophorus acuminatus,** comb. nov. Blatter and McCann.

Rottbœllia acuminata, Hack. Monogr. Androp. 291; Hook. f. F B. I. vii, 155; Cke. ii, 953.

Description : Cke. l. c.—We have examined Talbot's specimen No. 1291 and found that the lower involucral glume is much longer than 8 mm. (1/3 in.) going up to 10 and 12 mm.

Locality : Konkan : Marmagoa (Talbot 2572 !, 1291); Vasco da Gama (Herb. St. X. C. 9483 !); Malwan (Woodrow).—*Kanara :* Karwar (Talbot 3171 !, 2539, Hallberg and McCann A75 !, Lisboa); Katgal (Hallberg and McCann 9934 !); Castle Rock (Bhide !).

Distribution : W. Peninsula. Hooker f., but not Cooke, mentions also the Deccan Peninsula collected in by G. Thomson.

3. **Peltophorus Talboti,** comb. nov. Blatter and McCann.—*Rottbœllia Talboti,* Hook. f. in F. B. I. vii, 155 ; Cke. ii, 954.

Description : Cke. 1. c.

Locality : Konkan : Vasco da Gama (Bhide !) ; Marmagoa (Talbot 2572 !).

Distribution : So far only been found in Goa.

16. LASIURUS, Boiss. (Stapf in Fl. Trop. Afr. ix, 60)

Perennial, more or less branched and woody below ; branches often in dense fascicles, intravaginal. Leaves linear, convolute or flat, hard ; ligule a fringe of hairs. Racemes silky-villous. Spikelets usually 3-nate, rarely 2-nate, on the more or less fragile rhachis of villous spike-like racemes which end the stems and branches (if any) and are supported by or exserted from often spathaceous sheaths, if 3-nate 2 sessile, the sessile different in sex from, but similar in shape to, the pedicelled ; rhachis nodes bearded all round ; joints and pedicels linear, the latter more slender and shorter, opposite the joints if 2 sessile spikelets be present, otherwise approximate, but not contiguous and parallel to one of the sides of the joint ; disarticulation at a right angle to the rhachis, scar at the tips of the joints suborbicular, smooth, often ciliate. Sessile spikelets, if 2, one on each side of the pedicel with a narrow ring-shaped callus. Florets 2, lower male, upper bisexual, awnless. Glumes unequal ; lower longer, subcoriaceous, flat on the back, acuminate, 2-keeled upwards and 2-dentate, densely ciliate, upper boat-shaped, membranous, keeled. Valves hyaline, 3-nerved. Valvules hyaline, 2-nerved. Lodicules 2, cuneate. Stamens 3. Stigmas linear, laterally exserted. Grain oblong, slightly dorsally compressed, embryo half its length. Pedicelled spikelet similar to the sessile, but with an indistinct glabrous callus and with both florets male or more or less reduced.

1. **Lasiurus hirsutus,** Boiss. Diagn. ser. II, iv, 146 ; Stapf Fl. Trop. Afr. ix, 60.—*Saccharum hirsutum,* Forsk. Fl. Aegypt.—Arab. 16.—*Rottbœllia hirsuta,* Vahl Symb. i, 11 ; Hack. Monogr. Androp. 311.—*Ischæmum mastrucatum,* Trin. in Mém. Acad. Petersb. 6me. sér. ii, 298.—*Ischæmum hirsutum,* Nees in Schimp. Pl. Arab. Fel. No. 791.—*Cœlorrhachis hirsuta,* Brongn. *apud* Dcne. in Ann. Sci. Nat. ser. 2, ii, 13.—*Elionurus hirsutus,* Munro *apud* Benth. in Journ. Linn. Soc. xixv, 68 ; Boiss. Fl. Or. v, 466 ; Hook. f. in F.B.I. vii, 162 ; Cke. ii, 973.

Description : Cke. l.c.

Locality : Sind : Karachi (Bhide !) ; Sehwan to Laki, foot of hills (Sabnis B613 !) ; Umarkot, sandy plains (Sabnis B940 !).

Distribution : Nubia, Egypt, Brit. Somaliland, Arabia, Afghanistan, Baluchistan, Punjab, Sind, Rajputana.

17. ELYONURUS, Humb. and Bonpl. (Stapf in Fl. Trop. Afr. ix, 62)

Usually perennial, cæspitose, aromatic grasses. Blades of leaves flat or folded ; ligules very short, membranous. Racemes erect, joints strongly compressed, usually villous, tips oblique, not appendaged. Spikelets similar, usually awnless, differing in sex, 2-nate, one sessile, the other pedicelled, on the articulate fragile rhachis of solitary spike-like racemes, the sessile deciduous with the adjacent joint of the rhachis and the pedicel. Florets 2 : Lower reduced to an empty valve, upper bisexual in the sessile male, rarely barren, in the pedicelled spikelet. Glumes equal : Lower subcoriaceous to herbaceous, often 9-toothed or 2-fid, rarely awned, dorsally flattened, 2-keeled, usually with fine filiformed transparent balsam ducts close to the ciliate or penicillate keels ; upper membranous, lanceolate, acute, rarely awned. Valves hyaline, awnless. Valvule obsolete or absent. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong, dorsally compressed ; embryo about half the length of the grain.

Species about 15.—Tropical and subtropical regions of both hemispheres.

1. **Elyonurus Royleanus,** Nees ex. A. Rich. Tent. Fl. Abyss. ii, 471 ; Hack Monogr. Androp. 343 ; Hook. f. in F.B.I. vii, 161 ; Duthie Grass. N.W. Ind. 17, and Fodd. Grass. N. India 28, t. 54 ; Cke. ii, 972 ; Stapf in Fl. Trop. Afr. ix, 65.—*E. Griesebachii,* Schmidt, Beitr. z. Fl. Capverd. 154.—*Ratzeburgia Schimperi,* Steud. Nomencl. ed. ii, 439.—*Rottbœllia elegantissima,*

Hochst. ex. Steud. Syn. Pl. Glum. i, 365.—*Andropogon elegantissimus*, Steud. Syn. Pl. Glum. i, 365—*Andropogon Griesebachii*, Steud. Syn. Pl. Glum. i, 365.

Description : Cke. l.c.

Locality : Sind : (Woodrow).—*Gujarat :* Bhodir Maka, Cutch (Blatter 3747 !) ; Bhuj, Cutch (Blatter 3795 !) ; Rajkot, Kathiawar (Woodrow).

Distribution : Upper Gangetic Plain, Rajputana, W. Peninsula, Arabia, Somaliland, Eritrea, Abyssinia, Sudan, Nubia, Cape de Verd Islands.

18. ROTTBOELLIA, Linn. f. (Stapf. in Fl. Trop. Afr. ix, 72)

Annual, usually coarse grasses, often with stilt-roots from the lowest nodes, more or less branched, particularly upwards. Leaves large, linear-lanceolate, rather wide ; ligule membranous, short. Racemes dorsiventral, with the spikelets placed anticously and laterally. Spikelets 2-nate on the nodes of the very fragile rhachis of stout cylindric perfectly glabrous spike-like racemes which end the stems and their branches, in the latter case spathe-supported, different in sex and usually in size, colour and nervation except those of the uppermost pairs which are barren, homomorphous and upwards increasingly reduced forming a tail-like appendage to the raceme. Joints dorsally flattened below, widely cup-shaped and hollowed out upwards, more or less completely fused with the pedicels along their posticuous angles. Sessile spikelets pale, triangular in transverse section ; the narrow callus fused with the bases of the adjacent joint and pedicel into a glabrous ring from the centre of which protrudes a knob fitting into the cup-shaped hollow of the next lower joint, the whole plexus falling together. Florets 2, lower male, upper bisexual, awnless Glumes equal : Lower coriaceous, flat on the back, with very narrow inflexed margins, 2-keeled upwards ; upper boat-shaped, keeled upwards, acute. Valves hyaline, 3-nerved. Valvules as long or almost as long as the valves, hyaline, 2-nerved. Lodicules, 2, cuneate. Stamens 3. Stigmas suberect or shortly laterally exserted above the middle of the spikelet. Grain broad-oblong or ellipsoid, dorsally compressed ; hilum large, suprabasal ; embryo almost as long as the grain. Pedicelled spikelet similar to the sessile, but more compressed, green, striate, with two male florets, or smaller and more or less reduced.

Species 2 or 3.—Tropics of the Old World.

1. **Rottboellia exaltata,** Linn. f. Suppl. 114 ; Roxb. Pl. Corom. t. 157 ; Fl. Ind. i, 354 ; Duthie Grass. N.W. Ind. 17 ; Hack. Monogr. Androp. 293 ; Hook. f. in F.B I. vii, 156 ; Cke. ii, 955.—*R. exaltata*, var. *genuina*, Schweinf. in Höhnel Disc. Lakes Rudolf and Stefanie, ii, App. 352.—*R. exaltata*, f. *arundinacea*, Hack. in Bot. Soc. Brot. v, 215.—*R. arundinacea*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 444.—*Stegosia cochinchinensis*, Lour. Fl. Cochinch. 51.—*Stegosia exaltata*, Nash in Amer. Fl. xvii, i, 84.

Description : Cke. l.c.

Locality : Konkan : Dohe forest, Thana Dist. (Ryan 711 !).—*Deccan :* Agricultural College Farm (Herb. Econ. Bot. Poona !) ; Poona (Bhide !, Cooke, Woodrow 2 !) ; Purandhar 4,000 ft. (McCann 5591 !).—*S. M. Country :* Dharwar, in field (Sedgwick 5469 !) —*Kanara :* Hattikeri, near Karwar (Hallberg and McCann A74 !).

Distribution : India, Andamans, Ceylon, China, Malaya, Australia, Africa.

var. **robusta,** Hook. f. in F.B.I. vii, 156.

Description : Leaf-base more cordately confluent with the sheath. Spikes stouter below, slender above the middle. Spikelets in upper half distichously imbricate, longer than the joints, fertile nearly to the tip Pales of upper floral glume auricled at the base.

Locality : Poona (Woodrow).—We have not seen this plant.

Distribution : Malabar, Palamcotta.

19. OPHIURUS, Gærtn. *partim ;* R. Br. (Stapf Fl. Trop. Afr. ix, 74)

Annual (?) or perennial, sometimes very coarse grasses, usually much branched upwards. Leaves linear to lanceolate, short to very long, conduplicate or convolute in bud, then flat ; ligules very short, membranous. Racemes dorsiventral. Spikelets solitary on the nodes of the fragile rhachis of slender cylindric spikes which end the stems and their usually fascicled spathe-supported branches, their pedicelled companions suppressed or rudimentary and very minute and the pedicels completely fused with the joints, both forming together a deeply hollowed-out cylindric receptacle ; disarticulation of the internodes at a right angle or slightly oblique to the rhachis, their tips hollowed out. Sessile spikelet with a very narrow callus which is fused with the base of the internode into a rim from the centre of which protrudes a small knob fitting into the hollow of the next lower internode, the whole plexus falling together. Florets 2, lower male or neuter, upper bisexual, awnless. Glumes equal : Lower coriaceous, flat or subconvex on the back with very narrow inflexed margins, faintly nerved with a transverse groove at the base, upper boat-shaped, hyaline, obtuse. Valves hyaline, 2-nerved or nerveless. Valvules similar to the valves. Lodicules 2, cuneate. Stamens 3, Stigmas short, laterally exserted. Grain oblong, dorsally slightly compressed ; embryo 1/4 the length of the grain.

Species about 4.—From the Sudan through tropical Asia to Australia.

Stapf has described the species *Ophiurus megaphyllus* which forms part of *O. corymbosus*, Hook. f. in F.B.I. vii, 160 (not of Gærtn. f. and not of *Rottbœllia corymbosa*, Linn. f.). What is left over of Hook. f's *O. corymbosa* after the separation of *O. megaphyllus* has to go under *O. corymbosa*, Gærtn.

I. Leaves ensiform, very hairy. Robust, 1·5–1·8 m. 1. *O. megaphyllus.*
II. Leaves linear, glabrous. Slender, 0·6–1·2 m. ... 2. *O. corymbosus.*

1. **O. megaphyllus,** Stapf in Haines Bot. Bihar and Orissa pt. V (1924), 1058.—*Ophiurus corymbosus*, Hook. f. in F.B.I. vii, 160, *partim* (non Gærtn. f.); Cke. ii, 951, *partim ;* Hack. Monogr. Androp. 317 (*partim*).

Description : A large stout grass, 1·5–1·8 m. high, very leafy to the top. Leaves narrowly ensiform, tapering from base to apex, upper 10–18 mm. wide, lower much wider, flat, very hairy as are the sheaths, but more or less glabrescent with age, hairs with small tubercle bases, margins of sheath hirsute. Spikelets 2–4 mm., slightly shorter or longer than the joints, in very numerous peduncled spikes 7·5–10 cm. long, from the leaf-axils. Peduncles 7·5–12·5 cm., sheathed at the base, finally far exserted, each solitary on a branch with a villous node, often geniculate at the node. Sessile spikelets : Glumes 4 : Lower involucral glume oblong, glabrous, with rounded tip, smooth or with few lines of small pits, not becoming recurved, sometimes bearing a small appendage. Upper involucral glume white, becoming inclined forward, quite free from the rhachis when the spikelet opens. Pedicelled spikelets : the lowest are sometimes free at the top and bear a small brown free appendage.

Locality : We have not been able to examine all the specimens which were formerly put under *O. corymbosus*, Hook. f. and we are, therefore, not in a position, to assign any specimen to *O. megaphyllus*, Stapf.

Distribution : To make a definite statement all the herbarium material of *O. corymbosa*, Hook. f. would have to be examined.

2. **O. corymbosus**, Gærtn. f. Fruct. iii, 4, t. 181 f. 3 a (*Ophiuros*) ; Haines Fl. Bihar and Orissa, pt. V (1924), 1058 ; *Rottbœllia corymbosa*, Linn. f. Suppl. 114.—*O. corymbosa*, Hook. f in. F. B. I. vii, 160, *partim ;* Cke. ii, 951, *partim.*

Description : Perennial. Stems very numerous, glabrous, erect, slender, 0·6–1·2 m. high, bulbous at the base, the bulbous bases connected into a horizontal rhizome. Leaves linear, glabrous, up to 5 mm. broad, margins minutely tubercled at base, the tubercles bearing cilia when young. Spikes very slender, 5–12·5 cm. long, sometimes ending in a small tail like that of a rattle-snake (Haines), spikelets 2·5 mm. long, equalling the joint. Lower involucral glume of sessile spikelet glabrous, with many longitudinal lines of small pits, narrowly oblong, tip rounded, finally recurved.

Locality : Deccan : Deolali (Blatter and Hallberg 4564 !) ; Nasik Road (Blatter 9624 !) ; Talegaum (McCann !).

20. CŒLORRHACHIS, Brown. (Stapf in Fl. Trop. Afr. ix, 78)

Mostly tall, coarse, perennial grasses, much-branched upwards. Racemes with the sessile spikelets which are often imbricate, placed anticously and pedicelled laterally. Spikelets 2-nate on the nodes of the fragile rhachis of slender, more or less compressed conspicuously dorsiventral spike-like racemes which end the stems and their usually fascicled, spathe supported branches, different or very rarely alike in sex, similar in shape or the pedicelled more or less or very much reduced ; joints and pedicels similar or the latter more slender, linear to cuneate or subclavate, dorsally compressed, glabrous, contiguous or nearly so ; disarticulation of the joints at a right angle to the rhachis, their tips more or less hollowed out, with or without an ear-shaped appendage. Sessile spikelet dorsally compressed, the narrow transverse callus fused with the base of the adjacent joint and pedicel into an obscure rim from the centre of which protrudes a knob fitting into the hollow of the next lower joint, the whole plexus falling together. Florets 2, the lower usually reduced to the valve with a small valvule, always neuter upper bisexual, awnless. Glumes subequal ; lower flat or slightly convex on the back, smooth or variously sculptured, with narrow inflexed margins, 2-keeled upwards and more or less winged from the keels, obtuse or emarginate, very faintly nerved ; upper chartaceous, keeled, acute, 1–3 nerved. Valves hyaline, of lower floret 2-nerved or nerveless, of upper 3–1-nerved or nerveless. Valvule hyaline, similar to the valve, 2-nerved or nerveless Lodicules 2, cuneate. Stamens 3. Stigmas shortly laterally exserted. Grain oblong, dorsally compressed ; embryo about half the length of the grain. Pedicelled spikelet very varied, similar to the sessile or more or less reduced or rudimentary, male or neuter, very rarely bisexual.

Species about 12. Tropics of both hemispheres.

1. **Cœlorrhachis Clarkei** comb. nov. Blatter and McCann. *Rottbœllia Clarkei*, Hack. in Oestr. Bot. Zeitschr. 41 (1891), 8 ; Cke. ii, 954. *Rottbœllia gibbosa*, Hack. ex Lisboa in Journ. Bomb. Nat. Hist. Soc. vi. (1891), 195.
Locality : Kanara : Birchy (Talbot 2820 !, 2072) ; Jugglepet (Talbot 1566 !)
Distribution : Chota Nagpur, W. Peninsula.

(*To be continued*)

THE MOGHUL EMPERORS OF INDIA AS NATURALISTS AND SPORTSMEN

BY

SALIM A. ALI

PART II

(*With four plates*)

(*Continued from page 861 of Vol. XXXI*)

THE WILD ASS (*Equus onager indicus*)

According to Abul Fazl [1] the Wild Ass was hunted in the Sarkar of Tattah (Sind). He gives an account of a hunt by the Emperor Akbar (*circa* April, A.D. 1571) which took place at Harhāri near the River Sutlej (in the Punjab) as follows : " The scouts having reported that there was a herd of wild asses (*Gorkhar*), the sovereign proceeded to hunt them attended by three or four special huntsmen. When he came near the plain, he dismounted and proceeded on foot. At the first shot he hit an ass and the rest of the herd fled far away at the report of the gun. That Divine World Hero took his piece in his hand and proceeded rapidly on foot over the burning sand attended by the same three or four huntsmen. He soon traversed the plain and came up with the herd and killed one after the other with his gun ; he continued to follow them up and on that day he shot thirteen wild asses. Whenever he killed one the others went farther off than at first (before)." The chronicler tells us that Akbar followed this herd till thirst brought about such exhaustion that he lost the power of speech.

One of the items appearing on the list of game shot by Jehangir in the course of a *qamargah* hunt at Girjhāk (in the neighbourhood of Kalpi ?) is " ten Wild Asses ". [2] By the Emperor's orders the largest and strongest of these was weighed and found to be 9 maunds 16 seers equal to 76 Persian (*Vilayeti*) maunds (equivalent to 324½ lbs.). Regarding the qualities of its flesh as a table delicacy Jehangir observes : ' Though the flesh of the wild ass is lawful food (*halal*) and most men like to eat it, it was in no way suited to my taste.'

THE YAK (*Bos grunniens*)

Abul Fazl mentions[3] that this animal was found in the northern mountainous parts of the Subah of Kumaon. Further on he describes the animal as follows : " The Yak approximates to the domestic cow, but of its tail is made the '*kutas*' or fringed tassel and many they join together."

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[1] *Ain*, vol. ii, p. 338.

[2] *Jeh.*, vol. i, p. 83.

[3] *Ain*, vol. ii, p. 280.

Jehangir records [1] that one day two Yaks out of the offerings of the Zamindar of Tibet were brought before him and regarding these he observes: "All the limbs are covered with wool which properly belongs to animals in a cold country. For instance the ***Rang*** goat (Ibex) which they brought from the country of Bakkar (Sind) and the hill country of the Garmsir (Afghanistan) were very handsome but had little wool, and those that were met with in these hills (Tibet), on account of the excessive cold and snow are covered with hair and ugly. In form and appearance they (the Yaks) closely resemble the buffalo."

Jehangir is here doubtless, differentiating between the close-haired Ibex of the Sind Hills and its congener the Himalayan Ibex of the high altitudes of the Central Asian region.

According to Blanford the Yak in the wild state is only found within Indian limits in Northern Ladak in the neighbourhood of Chang Chenmo. Hodgson described it as occurring in the northern region of Nepal in the immediate vicinity of the snows. It is possible that the Subah or province of Kumaon in Akbar's day extended into Tibet which was a dependancy of the Moghul Empire.

The Wild Buffalo (*Bos bubalus*)

Babur describes [2] the animal thus: "It is much larger than the common buffalo. Its horns go back like those of the common buffalo, but not so as to grow into the flesh. It is a very ferocious and destructive animal."

Babur's view is upheld by Blanford and by most sportsmen of the present day that the wild buffalo is by far the most savage and the boldest of Indian Bovidæ.

The habitat of this beast at present is mainly Nepal, Assam, Bengal, Orissa and certain portions of Central India where it is locally distributed. In Akbar's time, according to his historian[3] wild buffaloes were numerous in Oudh. "When the plains are inundated," he informs us, "the animals take to high ground where people find sport in hunting them. Some of the animals remain all day in the water and only at night approach the dry ground and breathe in freedom."

According to the same author [4] various methods were employed in hunting the wild buffalo, the commonest being to decoy a bull by means of a tame cow on heat and to entangle him with nooses slipped round his legs by hunters lying in ambush.

Mountain Sheep (*Oorial or Burhel* ?)

Jehangir records [5] that in the course of two *Qamargah* hunts, one at Girjhāk and the other at Nadīnā (somewhere in the neighbourhood of Kalpi ?) one hundred and eighty mountain sheep were killed. The Emperor ordered a large ram to be weighed and it came to 2 maunds 3 seers (Akbari) equal to 70 Persian (Vilayeti) maunds which would be equivalent to 71½ lbs. It will be noted that the Moghul Emperors invariably appraised their game by weight, only in a very few instances is any attention paid to the length of horn and other dimensions so dear to the heart of the modern sportsman.

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[1] *Ibid.*, vol. ii, p. 151.
[2] *Babur*, vol. ii, p. 211.
[3] *Ain*, vol. ii, p. 125.
[4] *Ain*, vol. i, p. 293.
[5] *Jeh.*, vol. i, p. 83.

Continuing on the subject, Jehangir observes: "I have frequently heard from hunters and those fond of the chase that at a certain regular time a worm develops in the horn of the mountain ram, and this causes an irritation which induces the ram to fight with its hind, and that if he finds no rival he strikes his head against a tree or rock to allay the irritation. After inquiry it seems that the same worm appears in the horn of the female sheep, and since the female does not fight, the statement is clearly untrue."

The reference no doubt is to the larva of the parasitic fly *Œstrus ovis* L. which occurs in sheep causing the well-known giddiness.

THE 'RANG' OR IBEX (*Capra* sp.)

Jehangir[1] thus describes an ibex shot and brought to him: "It is like a mountain goat and there is a difference only in its horns. The horns of the 'Rang' are bent (backwards) and those of the goat (obviously meaning Markhor) are straight and convoluted."

In regard to 24 ibex which were captured alive in the course of a *Qamargah* hunt near Kabul, the Emperor observes[2]: "I had never till now seen a *Rang* antelope alive. It is in truth a wonderful animal of beautiful shape. Although the Black-buck of Hindustan looks very finely made, the shape and fashion and appearance of this antelope is quite a different thing. They weighed a *Rang* and it came to 2 maunds 10 seers (Akbari) (equal to 77½ lbs.). The *Rang* although of this size (i.e., heavy) ran so that 10 or 12 swift dogs were worn out and siezed it with a hundred thousand difficulties."

Jehangir describes his experiment of crossing the ibex with a Barbary goat in the following terms. The translation speaks of the former animal as "Markhor" but from the sketches of the goats, both parents and hybrids, made at the time (A.D. 1619) under the Emperor's orders it is apparent that the ibex and not the markhor was the species experimented with. Says Jehangir,[3] "At Ahmedabad I had two markhor (?) goats. As I had not a female in my establishment to pair with them, it occurred to me that if I could pair them with Barbary goats which they bring from Arabia, especially from the port of the city of Darkhar[4] young of their form and qualities might be obtained. In short I paired them with seven Barbary ewes (she-goats) and after six months had elapsed each of the latter had a young one at Fatehpur. There were four females and three males very pleasing in appearance, of good shape and good colour. In their colour, those kids which resembled the male were dun coloured with black stripes on their backs. . . . Of their liveliness and laughable ways and their manner of gamboling and leaping what can be written? Some of their ways are such that the mind derived uncontrolled pleasure from looking at them. . . . When one month or even 20 days old, they would leap

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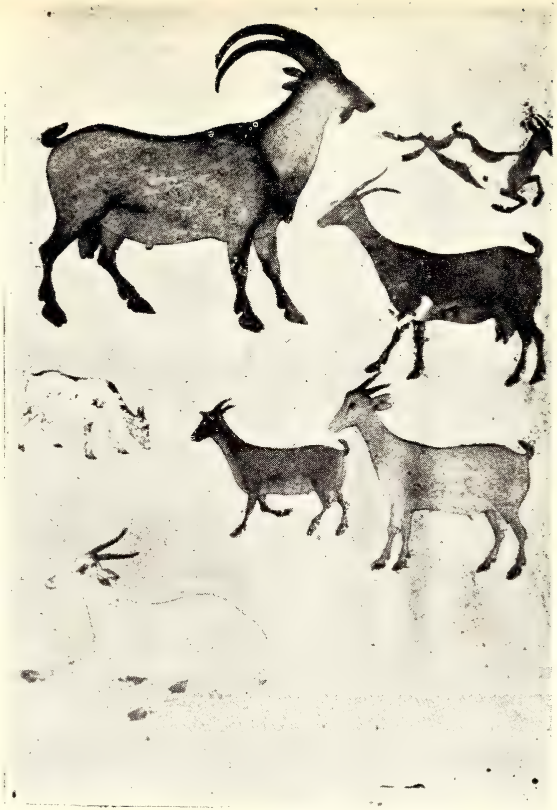
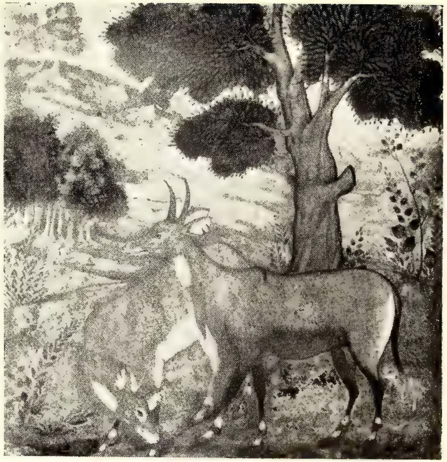
[1] *Jeh.*, vol. i, p. 109. [2] *Ibid.*, p. 121. [3] *Ibid.*, vol. ii, p. 88.

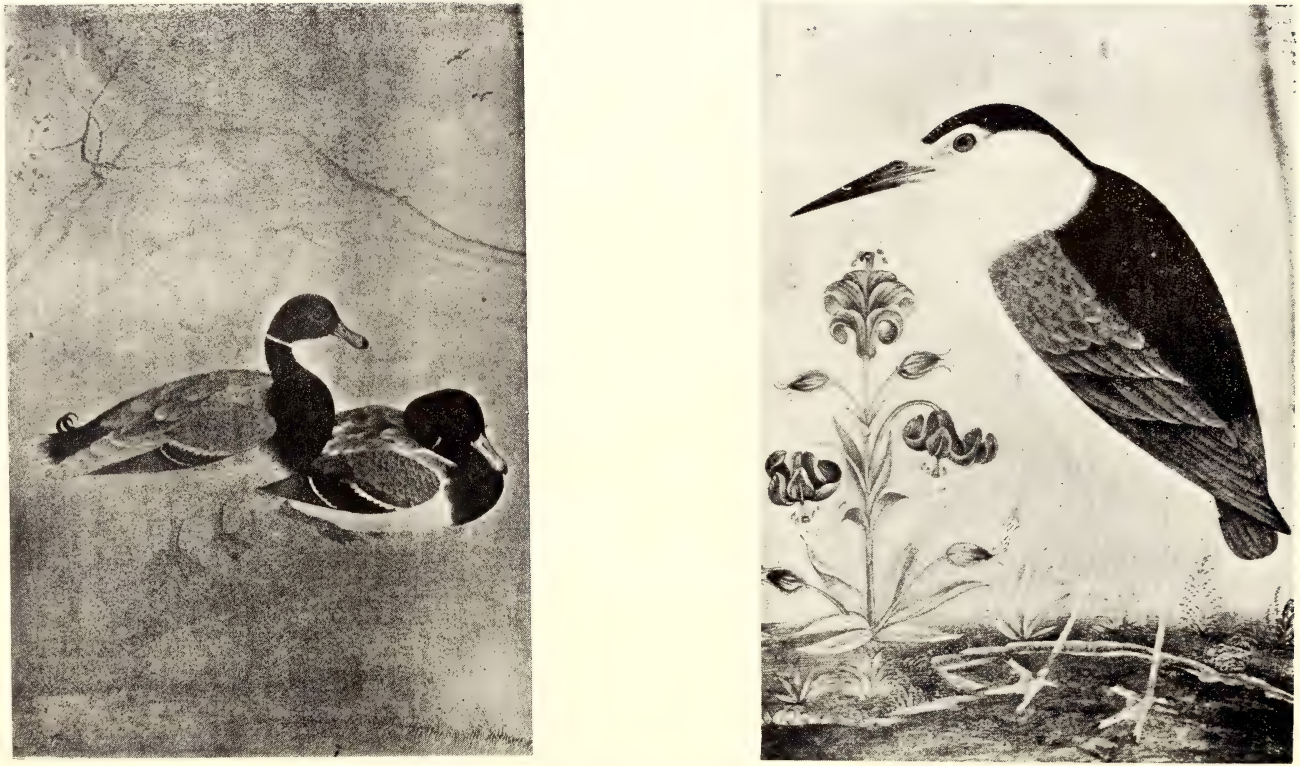
[4] The ancient Dhafar on the south coast of Arabia, known as Mirbat.



SKETCHES OF IBEX-GOAT HYBRIDS (SEE 'IBEX')
(Painted A.D. 1619; collection of M. Demotte, Paris.
By courtesy of the Publishers 'Indian Painting under the Moghuls.'—Percy Brown.



NILGAI.
(From a Moghul painting in the Prince of Wales Museum, Bombay.)



MALLARD AND NIGHT HERON (Painted A.D. 1630 ; Album of Prince Dara Shikoh ; India Office Library)
By courtesy of the Publishers, 'Indian Painting under the Moghuls.'—Percy Brown.

upon high places and throw themselves on the ground in a way that if any other but a kid were to do so, not one limb would be left entire. As it pleased me I ordered them always to be kept near me, and I gave each of them an appropriate name. I am much delighted with them and pay much attention to bringing together markhor (ibex) males and well-bred she-goats. I desire to have many young ones from them that they may become well known among men. After their young shall have paired, most probably more delicate ones will be obtained. One of their peculiarities is that ordinary kids, immediately they are born and until they begin to suck, make a great bleating, whilst these on the contrary make no sound and stand quite contented and without wailing. Perhaps their flesh would be very pleasant to the taste."

The agility of the ibex appears to have particularly excited the Emperor's amazement. He mentions[1] in regard to a tame ibex fawn eight days old that " it jumped down from the terrace of the palace which is 8 gaz (20 ft.) in height on to the ground and began to leap about, no sign of injury or pain being perceptible in it."

It is interesting to compare Jehangir's ibex-goat hybrids in the plate here reproduced with the photo illustrating a similar cross which appeared with a note by Col. A. E. Ward on page 519 of vol. xxxi of the Society's Journal.

THE MARKHOR (*Capra falconeri*)

I have no doubt that the animal referred to as " Mountain Goat " in Jehangir's memoirs is no other than this. The Emperor mentions that as compared with the *Rang* (ibex) whose horns are bent backwards, the horns of this animal were straight and convoluted. This clue alone would suffice to establish its identity. Jehangir[2] continues on the subject: " I found the flesh of the Mountain Goat more delicious than of all wild animals; although its skin is exceedingly ill-odoured, so much so that even when tanned the scent is not destroyed. I ordered one of the largest of the Hill Goats to be weighed; it was 2 maunds and 25 seers equal to 21 foreign (Persian or Vilayeti) maunds."

The weight would be equivalent to 90½ lbs.

THE NILGAI OR BLUE BULL (*Boselaphus tragocamelus*)

The first Moghul emperor to refer to this animal was Babur, who described it in his Memoirs[3] thus: " Its height is equal to that of a horse. It is somewhat slender. The male is bluish whence it is called the *Nil-gau* (Blue Ox). It has two small horns and on his neck has some hairs, more than a span in length, which bears much resemblance to the mountain-cow's (yak) tassels.[4] Its tail is like the bull's. The colour of the female is like that of the 'Gawazen' deer (Red Deer)."

All the Moghul emperors appear to have been extremely fond of hunting the Nilgai. Jehangir in particular was devoted to it, and makes repeated references to the sport in his memoirs. I give an account of one such hunt in the Emperor's own words which will suffice our purpose. He writes : " On this day (in A.D. 1610) was killed a Nilgau of the weight of 9 maunds and 35 seers (equivalent to 340¾ lbs.). The story of this nilgau is written because it is not devoid of strangeness. In the past two years during which I had come to this same place to wander about and hunt, I had shot at him each time with a gun. As the wounds were not in a fatal place, he had not fallen but gone off. This time I again saw that nilgau in the hunting ground and the watchman recognized that in the two previous years he had gone away wounded. In short I fired at him again three times that day. It was in vain. I pursued him rapidly on foot for 3 kos but however much I exerted myself I could not catch him up. At last I made a vow that if this nilgau fell I would have his flesh cooked, and for the sake of Khwājā Muīn-ud-dīn (who was Jehangir's patron saint) would give it to eat to poor people. I also vowed a muhr (gold mohur) and a rupee to my revered father. Soon after this the nilgau became worn out with moving and I ran to his head and ordered them to make it lawful (cut its throat in the name of Allah) on the spot, and having brought it to the camp I fulfilled my vow as I had proposed. They cooked the nilgau, and expending the muhr and rupee on sweets, I assembled poor and hungry people and divided these among them in my own presence.

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[1] *Jeh.*, vol. ii, p. 204.

[2] *Ibid.*, vol. i, p. 83.

[3] Vol. ii, p. 211.

[4] Known as *kutas* or *qutas*.

Two or three days afterwards I saw another nilgau. However much I exerted myself and wished he would stand still in one place so that I might fire at him, I could get no chance. With my gun on my shoulder I followed him till near evening until it was sunset and I despaired of killing him. Suddenly it came across my tongue " Khwājā, this nilgau is also vowed to you." My speaking and his sitting down were at one and the same moment. I fired at him and hit him and ordered him like the first nilgau to be cooked and given to the poor to eat."[1]

From the above account it will be seen that unlike so many potentates of the present day, the Moghul emperors spared no personal exertion in pursuit of sport.

The killing of female game was apparently not looked upon as unsporstmanlike in Jehangir's time. He tells us that he once shot a female nilgau from the stomach of which two fully formed fœtuses were obtained. " As I had heard," writes the Emperor, " that the flesh of nilgai fawns was delicate and delicious, I ordered the royal cooks to prepare a *dupiyaza* (a kind of rich fricassee,[2]) and he remarks that " certainly it was not without flavour."

THE FOUR-HORNED ANTELOPE (*Tetracerus quadricornis*)

Jehangir[3] writes : " On the road to the village of Qāsim-khēra in the Subah (province) of Mālwa a white (probably meaning pale brown) animal was killed which resembled the *Kotah-payeh* (Hog Deer) ; it had four horns, two of which were opposite the extremities of its eyes and two finger-breadths in height, and the other two horns 4 finger breadths towards the nape of the neck. These were 4 finger breadths in height. The people of India call this animal *Dūdhādhārit*. The male has four horns and the female none. It was said that this kind of animal had no gall-bladder, but when they looked at its intestines the gall-bladder was apparent, and it became clear that this report has no foundation."

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[1] *Jeh.*, vol. i, p. 189.

[2] *Ibid.*

[3] *Jeh.*, vol. i, p. 352.

One of the Hindustani names for the four-horned antelope is *Doda*, which may be an abbreviated form of that mentioned by Jehangir.

THE INDIAN ANTELOPE OR BLACK BUCK (*Antilope cervicapra*)

In dealing with the fauna of Hindustan, Babur[1] refers to this animal in the following terms: "There is a species of deer that resembles the male *huneh* or *jiran*.[2] Its back is black, its belly white, its horns longer than those of the *huneh* and more crooked. The Hindustanis call it *kalhāreh*. The word was probably *kālā hiran* (black deer), which they have corrupted into *kalhāreh*. The female is white (meaning doubtless, pale brown). They take the deer by means of this *kalhāreh*. They make fast a running net to its horns and tie a stone larger than a football to its leg, that after it is separated from the deer it may be hindered from running far. When the deer sees the wild *kalhāreh* it advances up to it presenting its head. This species of deer is very fond of fighting and comes on to butt with its horns. When they have engaged and pushed at each other with their horns, in the course of their moving backwards and forwards, the net which has been fastened to the tame one's horns gets entangled in those of the wild deer and prevents its escape. Though the wild deer uses every effort to flee, the tame one does not run off and is greatly impeded by the stone tied to its leg which keeps back the other also. In this way they take a number of deer which they afterwards tame. They likewise take deer by setting nets. They breed this tame deer to fight in their houses. It makes excellent battle."

Writing in the reign of the Emperor Akbar, the historian Abul Fazl, after enumerating a number of methods then in vogue for hunting and capturing black buck, the most popular of which has been so graphically described by Babur and is still employed, informs us that regular deer studs were maintained where black buck were bred and trained as decoys for catching and hunting wild antelope.

While on the subject of black buck, Jehangir recounts an incident which he says "has been written because it is not void of strangeness. At Chāndwālah I had wounded in the belly a black antelope. When wounded a sound proceeded from him such as I have never heard from any antelope except in the rutting season. Old hunters and those with me were astonished and said they never remembered, nor had they heard from their fathers that such a voice issued from an antelope except at the rutting season."

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[1] *Babur*, vol. ii.

[2] It has been suggested that this may be either *Gazella subgutturosa* or *Saiga tartarica*.

He further relates[1] that while hunting in the pargana of Karnal (Punjab) with about 30 of his huntsmen (*circa* 1618 A.D.) they came in sight of a black buck with some does. "We let loose a decoy antelope to fight him. They butted two or three times and then the decoy came back. A second time I wanted to put a noose on its horns and let it go that it might capture the wild one. Meanwhile the wild antelope in the excess of his rage, not looking at the crowd of men (i.e., unmindful), ran without regard to anything, and butting the tame buck two or three times, fought with it till it fled. The wild antelope thereupon made its escape."

The traveller Mons. de Thevenot, who visited India during the regime of Aurangzebe, writes of the black buck and the methods of capturing it as follows:—" The Indian Antelope are not altogether like those of other countries ; they have even a great deal more courage, and are to be distinguished by their horns. The horns of the ordinary antelope are greyish, and but half as long as the Horns of those in the Indies which are blackish and a large Foot and a half long. The Horns grow winding to a point like a screw ; and the Faquirs and Santons carry commonly two of them pieced together ; they are armed with iron at both ends, and they make use of them as of a little staff.

When they use not a tame Leopard for catching of Antelopes, they take with them a male of the kind that is tame, and fasten a Rope about his Horns, with several nooses and doubles, the two ends whereof are tied under his belly ; so soon as they discover a Heard of Antelopes, they slip this male and he runs to join them. The Male of the Heard advances to hinder him, and making no other opposition but playing with his horns, he fails not to be pestered and entangled with his rival, so that it being uneasy for him to retreat, the Huntsman cunningly catches hold of him and carries him off ; but it is easier to catch the male than the females."

Here again we find that the favourite method of capturing black buck was the same as employed in Babur's time, over a century previously. The dodge as practised to-day shows very little modification.

THE CHINKARA (*Gazella bennetti*) OR MUNTJAC (*Cervulus muntjac*)?

Sir Lucas King, the annotator of Erskine's translation of Babur's Memoirs, in a footnote conjectures that the animal described by the Emperor in the following words may be a Chinkara. If this view is correct, it appears curious that Babur should not have remarked upon the similarity of this animal to the Persian Gazelle (*Gazella subgutturosa*) which was evidently familiar to him (cf. Black Buck) and closely allied to this species. Babur states :—" There is on the skirts of the mountains another deer which is smaller ; it may be equal in size to a sheep of a year old."

In view of the somewhat vague account, I think it may be permissible to hazard a guess that possibly the Muntjac is what is meant.

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[1] *Jeh.*, vol. ii, p. 42.

RED DEER (?)

The identity of this animal is uncertain. According to Jehangir[1] they were plentiful in the hills of Rohtas (Punjab) ? and were found nowhere else in Hindustan except at Girjhāk and Nandāneh (near Kabul ?) The Emperor writes :—" I ordered them to catch and keep some of them alive in order that possibly some of them might reach Hindustan for breeding purposes."

Unfortunately no further records are available regarding this proposed introduction of the deer.

Is it possible that the Emperor is here referring to the Eastern Red Deer, misnamed the Maral, (*Cervus elaphus maral*) whose range extends from the Caucasus to Northern Persia and may have in Babur's day included Afghanistan and the neighbouring provinces of the Punjab ?

The only mention of Sambar (or Barasinga ?) made in Jehangir's notes is in his game register. In the list of game killed by him which appeared with the first part of this article, one of the items is *Maka* which for the reason stated in my footnote, may refer to either to Sambhar or Swamp Deer (*Barasinga*). As mentioned by Blanford, *Mâhâ* is the Hindi name for the Swamp Deer and *Mahâ* the Terai for Sambar.

THE HOG DEER (*Hyelaphus porcinus*)

Babur describes this deer which he calls *Kotah paicheh* (i.e. " Shortlegged ") as follows : " Its size may be equal to that of the white deer. Its forelegs as well as its thighs are short whence its name. Its horns are branching like those of the *gawazen* (Red Deer) but less. It is a bad runner and therefore never leaves the jungle."

Akbar's chronicler, Abul Fazl, mentions [2] that the sport of hunting this deer was much pursued in the Sarkar of Tattah—the present Sind. The animal is still plentiful in the tamarisk forests in the Indus and canal areas of that province and the zamindars display considerable fervour and ingenuity in hunting it.

THE MUSK DEER (*Moschus moschiferus*)

Abul Fazl [3] refers to this little animal in his Fauna of Hindustan thus : " The deer from which the musk is taken is larger than a fox, and his coat is rough. He shows two tusks or protruberances in place of horns. They are common in the northern mountains." In regard to its distribution the same author observes[4] that the Musk Deer was found in the Subah of Kumaon.

The Emperor Jehangir mentions [5] that while in Kashmir, the Zamindar of Tibet brought him a Musk Deer as offering. About this he writes : " As I had not tasted its flesh, I ordered it to be cooked ; it appeared very tasteless and bad for food. The flesh of no other animal is so inferior. The musk bag when fresh has no scent, but when it is left for some days and becomes dry it is sweet scented. The female has no musk bag."

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[1] *Jeh.*, vol. i, p. 129. [2] *Ain*, vol. ii, p. 338. [3] *Ain*, vol. iii.
[4] *Ain*, vol. ii, p. 280. [5] *Jeh.*, vol. i, p. 151.

It is interesting to compare Jehangir's verdict on the flesh of this species as an article of food with Blanford's, who considers it as excellent and free from any musk flavour.

THE INDIAN WILD BOAR (*Sus cristatus*)

According to Abul Fazl[1] the Wild Boar was much hunted in the Sarkar of Tattah (Sind) where it is still plentiful and a serious pest to cultivation.

Jehangir mentions[2] that two pigs formed part of his bag in a *Qamargah* hunt which took place at Rawalpindi.

Sir Thomas Roe, the English Ambassador from James I to the court of Jehangir, writes in his journal[3] that on one occasion the king returning from a hunt "sent me a wild boar so large that he desired the tusks might be sent him back for their extraordinary size, sending word he had killed it with his own hand and bidding me eat it merrily."

Some time later, he again notes: "The king returning from hunting sent me a wild boar."

THE GANGETIC DOLPHIN (*Platanista gangetica*)

The animal referred to by Babur as *Khūk-e-ābi* is doubtless this species. From the fact that he describes it along with his crocodiles and fishes, it may be doubted if the Emperor realized its true position. Of course, by analogy of habitat alone it has at least as much right to be classed with the fishes as Babur's Flying Fox had to be with his birds.

The cetacean is thus described: "It is found in all the rivers of Hindustan. It springs up from the water with a jerk, puts up its head and plunges it down again, leaving no part of its body visible except the tail. The jaw of this animal too is like that of the crocodile. It is long and has the same kind of ranges of teeth; in other respects its head and body are like that of a fish. While playing in the water it resembles a water bag (mushak). The *khūk-e-ābi* (water hogs) that are in the River Saru (the Sirju or Gogra) while sporting leap right out of the water. This animal too resembles the fish in never leaving the water."

BIRDS

THE CROW (*Corvus splendens* ssp. ?)

In dealing with the birds of his new dominions, Babur describes[4] what he calls the "*Alā-khūrgeh* of Hindustan" as follows: "It is slenderer and smaller than the *Alā-khūrgeh* of my native country and it has some white (? whitish) on the neck." Babur undoubtedly refers to the Hooded Crow (*Corvus capellanus*) in speaking of the crow of his country.

In a footnote, Sir Lucas King suggests that the bird referred to may be the Carrion Crow (*Corvus cornix sharpi*) but as this is by no means a common species (being a somewhat rare visitor to the extreme north-west of India only) and besides has no grey or white about the neck which is glossy black, I am inclined to believe it highly probable that Babur's bird is no other than our vulgar friend the House Crow—possibly *C. s. zugmeyeri* the Sind Crow, which has a particularly pale, almost whitish neck.

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[1] *Ain*, vol. ii, p. 338.

[2] *Jeh.*, vol. i, p. 129.

[3] *Pinkerton's Travels*, vol viii,

[4] *Babur*, vol. ii, p. 221.

THE TREE PIE (*Dendrocitta rufa* ssp. ?)

" Another is the *Aakeh* of Hindustan ; they call it *mita*. It is a little smaller than the common *aakeh* (magpie) which is particoloured black and white, while the *mita* is particoloured brown and black." [1]

THE GREEN MAGPIE (*Cissa chinensis chinensis*)

Babur's description of what may possibly be this bird is very vague. He compares it in appearance to the *Shiqraq* which according to King, is the Arabic name for the Green Magpie, and says, " It lives close among and about trees, and may be about the size of a *shikrak*. It is green-coloured like the parrot."

Abul Fazl's reference to it is somewhat more definite. Among the birds found in the Sarkar of Sylhet (Assam) he mentions one as the *Sherganj* and says, " It is of the same kind (as the Racket-tailed Drongo) but its beak and legs are red ; in imitating sounds it matches the other, and pursues sparrows and the like and eats them." Among the vernacular names of this bird in the *F.B.I. Birds*, vol. i, 1st and 2nd editions, both Oates and Stuart Baker give *Sirganj* as the Bengali. The latter states that its food consists of insects, small unfledged birds, etc.

THE RACKET-TAILED DRONGO (*Dissemurus paradiseus* ssp. ?)

Abul Fazl[2] describes this bird from the Sarkar of Sylhet (Assam) thus : " The *Bhangrāj* is a bird of black colour with red eyes and a long tail. Two of the feathers extend to the length of a *gaz*. They are snared and tamed. It catches the note of any animal that it hears and eats its flesh."

THE SCARLET MINIVET (*Pericrocotus speciosus*)

Another bird which Babur compares in size to the *Sandulaj-mamula*, (which according to King is the Arabic for Wagtail) is probably this bird. The Emperor says " It is of a beautiful red, and on its wings has a little black."

THE DIPPER

Jehangir writes in Kashmir as follows : "I rode to see Sukh Nag.[3] It is a beautiful summer residence (*Ilaq*). The waterfall is in the midst of a valley and flows down from a lofty place.

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[1] *Babur*, vol. ii, p. 222.

[2] *Ain*, vol. ii, p. 125.

[3] Perhaps this is the Shakar Nag of Jarrett (*Ain*, vol. ii, p. 361). The Sukh Nag River is mentioned by Laurence, 16. It may also be the waterfall mentioned by Bernier who says Jehangir visited the place and had a rock levelled in order to see properly.

There was still ice on its sides. . . . In this stream I saw a bird like a *Saj*. The *Saj* is of a black colour with white spots, while this bird is of the same colour as a bulbul (brown) with white spots, and it dives and remains for a long time underneath and then comes up from a different place. I ordered them to catch and bring two or three of these birds that I might ascertain whether they are waterfowl and were web-footed, or had open feet like land birds. They caught two and brought them. One died immediately and the other lived for a day. Its feet were not webbed like a duck's. I ordered Nadir-ul-asr Ustad Mansur (the celebrated animal painter) to draw its likeness. The Kashmiris call it *Galkar* that is ' Water *Saj* '."

This bird is either the Kashmir Dipper (*Cinclus c. cashmeriensis*) or the Indian Brown Dipper (*Cinclus pallasi tenuirostris*). The *Saj* to which it is compared may be the Spotted Forktail. Unfortunately I have no access to a reproduction of Al Mansur's painting referred to. This would doubtless have set the matter at rest.

STARLINGS, MYNAHS, ETC.

Babur mentions[1] the *Shārak* which he says " abounds in the Lamghanat and everywhere lower down over the whole of Hindustan. The *Shārak* is of different (various) species. One is that which is found in great numbers in the Lamghanat. Its head is black, its wings white, its size is rather larger than the *Chughur* and slenderer. It learns to speak."

In a footnote to this, King says: " The Persian has *Jāl* which is the Bokhara lark—*Melanocorypha torquata*—a common cage bird in India. *Chughur* is a large species of lark. The bird referred to here must be some sort of starling, possibly *Sturnus humii*." I can hardly imagine that King is correct in his conjecture. I have never heard of *Sturnus humii* sporting white wings ! Mrs. A. S. Beveridge, in her translation of the *Memoirs*, remarks " *Chughur-chug* in E. D. Ross's *Polyglot List of Birds* (p. 314) is the Northern Swallow. The description allows it to be *Sturnus humii*—the Himalayan Starling." (? ?)

Babur proceeds : " There is another sort which they call *Pindāweli*. They bring it from Bengal. It is all black. It is much larger than the other *Shārak*. In its two ears are yellow leathers which hang down and look very ugly. They call it the *Myna*. It learns to speak well and fluently."

This bird is obviously the Hill Mynah (*Eulabes intermedia*), a favourite cage bird, talker and mimic.

" There is another kind of *Shārak* a little slenderer than this last (the Persian adds, they call it *Wan Shārak*). It has red round the eye. This kind does not talk." King suggests in a footnote that this is possibly *Calornis chalybeius*—the Glossy Starling or Tree Stare. It is possible that his surmise may be correct though this species has no red round the eye, unless the irides are meant. To my mind the description suggests *Acridotheres ginginianus*, the Bank Myna.

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[1] *Babur*, vol. ii, p. 216

THE BAYA (*Ploceus baya*)

Abul Fazl says, " The Baya is like a wild sparrow but yellow. It is extremely intelligent and docile ; it will take small coins from the hand and bring them to its master, and will come to call from a long distance. Its nests are so ingeniously constructed as to defy the rivalry of clever artificers."

THE SPARROW

Abul Fazl remarks upon the scarcity of these birds in the Province of Kashmir, and ascribes it to the general use in that country of pellet bows fitted with bow strings. Some doubt may be pertinently expressed as to the bird referred to in this note.

One of Akbar's diversions was to catch sparrows by the agency of frogs trained for the purpose.

THE WAGTAIL

One of the things Jehangir records from the fortress of Māndu (in the present Dhar State) which he had never seen before in Hindustan was " the nest of a Wagtail (*Māmūla*) which they call in Persian *Dūm-sichā* (' Tail wagger '). Up till now, none of the hunters had pointed out its nest. By chance in the building I occupied there was its nest, and it brought out two young ones."

This wagtail would obviously be *Motacilla lugubris maderaspatensis*—the Large Pied Wagtail, which is the only resident species that breeds in India south of the Himalayas. This is the species, moreover, that is especially partial to holes in walls and buildings both empty and occupied for nesting sites.

THE PIED CRESTED CUCKOO (*Clamator jacobinus*)

Jehangir says,[1] " In Hindustan there is a bird called *Papiha* of a sweet voice, which in the rainy season utters soul-piercing (*jān-sūz*) lament. As the Koyel lays its eggs in the nest of a crow and the latter brings up its young, so I have seen in Kashmir that the *papiha* lays its eggs in the nest of the *ghaughāi* (probably some species of babbler) and the *ghaughāi* brings up its young."

Abul Fazl writes about this cuckoo as follows : " It is a smaller bird than the koel with a shorter and slenderer tail. Its love is chanted in story. It is in full song in the beginning of the rainy season and has a peculiar note, and its plaintive strain is heard oftenest at night and makes love's unhealed wounds bleed anew. It is from its note that the word *piu* is taken, which in Hindi signifies ' Beloved. ' "

THE KOEL (*Eudynamis scolopaceus scolopaceus*)

Babur says about it :—" Its length may be equal to the crow but is much thinner. It has a kind of song and is the nightingale of Hindustan. It is respected by the natives of Hindustan as much as the nightingale by us. It inhabits gardens where the trees are close planted."

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[1] *Jeh.*, vol. ii, p. 164.

At a later date, Abul Fazl in his fauna of Hindustan refers to the bird as follows :—" The Koel is like a myna, jet black with crimson irides and a long tail. The romance sings of its loves as of those of the bulbul."

Jehangir's observations on the bird and its parasitic habits are remarkably thorough. He writes :—" The koel is a bird of the crow tribe but smaller. The crow's eyes are black and those of the koel red. The female has white spots but the male is all black. The male has a very pleasant voice quite unlike that of the female. It is in reality the nightingale of India. Just as the nightingale is agitated and noisy in Spring, so is the cry of the koel at the approach of the rainy season, which is the Spring of Hindustan. Its cry is exceedingly pleasant and penetrating, and the bird begins its exhilerations (*masti*) when the mangoes ripen. It frequently sits on the mango trees and is delighted with the colour and scent of the mango (a fruit of which the emperor himself was inordinately fond !) A strange thing about the koel is that it does not bring up its young from the egg, but finding the nest of the crow unguarded at the time of laying, it breaks the crow's eggs with its beak and throws them out, and lays its own in the place of them and flies off. The crow thinking the eggs its own, hatches the young and brings them up. I have myself seen this strange affair at Allahabad."

THE CROW PHEASANT (*Centropus sinensis*)

Babur describes the bird[1] as follows :—" This (bird) bears some resemblance to the Carrion Crow. In the Lamghanat they call it the Wood Fowl. Its head and breast are black, its wings and tail red; its eyes a very deep red. From its being weak and flying ill, it never comes out of the woods whence it gets its name of the Wood Fowl."

PAROQUETS

On the subject of the Paroquets of Hindustan, Babur writes[2] " There are many species of parrot; one is that which they carry into our countries (i.e. Turkestan) and teach to talk (*Palæornis nepalensis ?*). There is another species of smaller size which is also taught to speak. They call it the ' Wood Parrot ' (*P. torquatus ?*). Great numbers of this species are found in Bajour, Sawād and the neighbouring districts, insomuch that they go in flights of five or six thousand. These two species differ only in bulk—both have the same colours. There is another species of the parrot which is still smaller than the wood parrot. Its head is red as well as its upper feathers ; from the tip of its tail to within two fingers' breadth of its feet it is white. The head of many of this species is lustrous, and they do not speak. They call it the Kashmir Parrot."

I am afraid this last bird cannot be placed with any degree of certainty though it may of course be *P. cyanocephalus*, the Blossom-headed Paroquet. This species, however, has none of the white mentioned in the description, unless the pale yellowish-green undertail coverts are so described. Moreover, the upper feathers are not red, unless the reference is to the wing-patches only.

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[1] *Babur*, vol. ii, p. 222.

[2] *Ibid.*, pp. 214–15.

Babur continues: "There is another species of parrot like the wood parrot but a little less. Its beak is red; round its neck is a broad black circle like a collar. Its upper feathers are crimson; it learns to speak well." This would appear to be *P. nepalensis*, the Large Indian Paroquet, a favourite cage bird in India, though in size it is larger, and not smaller, than *P. torquatus*.

"There is another kind of parrot of a beautiful red colour, it has also other colours, as I preciously do not recollet its appearance, I therefore do not describe it particularly. It is a very elegant bird and learns to talk; it has one great defect that its voice is particularly disagreeable as if you rubbed a piece of broken china on a copper plate."

The identity of this bird is obscure. It certainly does not appear to be *Coryllis vernalis* as suggested by King, as the colour of this species is green with scarlet patches on the rump and uppertail coverts only. Besides, I have never heard of a Lorikeet learning to talk, and its voice cannot be said to agree with Babur's graphic description. The only Indian bird that strikes me as being possibly referred to is *P. fasciatus* the Red-breasted Paroquet, which is found throughout the lower Himalayas, although its cry according to Blanford is much less harsh than that of either *P. torquatus* or *P. nepalensis*.

LORIKEET (*Coryllis vernalis*)

Once, when Jehangir was at Ajmere he narrates that "they brought a bird from the country of Zerbad (Arrakan, Sumatra, etc.) which was coloured like a parrot but had a smaller body. One of its peculiarities is that it lays hold with its feet of the branch or perch on which they may have placed it and then makes a somersault and remains in this position all night and whispers to itself. When day comes it seats itself on top of the branch. Though they say that animals have worship, yet it is most likely that this practise (whispering ?) is instinctive. It never drinks water and water acts like poison upon it, though other birds subsist on water."

A curious observation indeed! In captivity at least the bird drinks freely without dire consequences.

EAGLES, KITES, FALCONS, ETC.

The *Zumej* described by Babur as being of the size of a *burquat* or falcon and of a black colour, may for all we know be the Black Hawk-eagle (*Ictinaëtus malayensis*) as suggested by King. According to the commentator *Zumej* is the Arabic name for *Dubara* or *Du-barādarān* (i.e. "Two brothers") so called because they hunt in couples. He thinks *burquat*, to the size of which the Emperor compares the bird, may be the Golden Eagle (*Aquila chrysaëtus*). In Hindi the Imperial Eagle (*A. heliaca*) is known as *Jūmiz* or *Barājumiz*.

Babur[1] refers to another bird, the *Sar* and all he tells us about it is that "its tail and back are red." I am unable to conjecture what grounds King has for suggesting that it may be the Rosy Pastor (*Pastor roseus*). According to Mrs. Beveridge the word *Sar* in Turki means a buzzard, and this, coupled with the fact that it is included by Babur with his birds of prey, is I think good justification for the alternative surmise that the description may refer to the Brahminy Kite (*Haliastur indus*), a bird held in some esteem by the later Moghuls and looked upon as favourable omen in time of battle.

Abul Fazl, after a brief account of the birds and animals found in Kashmir, goes on[2] to enumerate the various attractions of the country and says: "The people take pleasure in the skiffs upon the lakes, and their hawks strike the wildfowl in mid-air and bring them to the boats; sometimes they hold them down in the water with their talons and stand on them presenting an exciting spectacle."

Fr. Monserrate, the Jesuit already referred to in the foregoing pages, writing about the popularity of the sport of hawking in the reign of the Emperor Akbar states: "The Moghuls are not very fond of hawking. It is regarded however, as a mark of royal dignity for the King to be accompanied on the march by fowlers carrying many birds on their wrists. These birds are fed on crows to save expense." It would appear from another statement of the same writer elsewhere that hunting leopards were much more popular at this period, though Abul Fazl's accounts indicate that both forms were equally in vogue.

Jehangir chronicles[3] that about the year 1618 A. D. an ambassador he had sent to the King of Persia sent him an *āshyāni* falcon. meaning "a bird from the nest"—evidently much prized by falconers. He remarks that in the Persian language, such a bird is known as *Ūknā* (an Arabic word signifying "nest"). "Outwardly" the Emperor observes, "one cannot distinguish between these and the *bāz-e-dāmi* falcons by any particular mark, but after they have been flown the difference is clear."

Bāz-e-dāmi apparently means hawks reared in captivity. It is maintained that birds taken young and trained by man never attain the standard of wild birds trained by the parents.

Whenever the king visited a nobleman at his house, which, as Jehangir puts it, "increased his dignity among his equals and neighbours," it was customary for the host to offer the monarch horses, daggers, hawks and falcons the very best he possessed—which were usually exchanged by the emperor with similar presents.

Describing Kashmir, Jehangir[4] mentions that "among the excellencies (of that Province) are the Hawks (*Janāwar-e-shikāri*). Hawks and Falcons are taken in nets. . . . It has also "nest" (*ukna*) sparrow-hawks (*bāsha*) i.e. taken from the nest and not reared (in captivity) and the nest sparrow-hawk is not bad."

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[1] *Babur*, vol. ii, p. 221.

[2] *Ain*, vol. ii, p. 351.

[3] *Jeh.*, vol. ii, pp. 10-11.

[4] *Ibid.*, p. 178.

The information which Abul Fazl furnishes with regard to the prices current for hawks and falcons in the time of Akbar is interesting. The historian writes[1] "From eagerness to purchase and from inexperience, people pay high sums for falcons. His Majesty allows dealers very reasonable profits ; but from motives of equity he has limited the prices. The dealers are to get their gain, but buyers ought not to be cheated."

We learn that the hawks were divided into various classes according to their merits, and their prices scheduled accordingly as follows :

First Class—*Khāna kurz*, i.e. Birds that had moulted whilst in charge of experienced trainers and had got new feathers. These *bāz* (hawks) cost 12 *muhurs* (equivalent to 192 rupees). There was also a second grade in this class of falcons.

Second Class—*Chōz*, i.e. Birds that had not yet moulted. The price fixed for this class was 10 *muhurs* (Rs. 160).

Third Class—*Tārinak*, i.e. Birds that had moulted before capture. These were somewhat cheaper than *Chōz*.

It will be seen that the ubiquitous profiteer is not a product of modern times, but that his nefarious activities needed curbing legislation as long ago as Akbar's day !

GREEN PIGEON

In his avifauna of Hindustan, Abul Fazl mentions the *Harial* (*Crocopus phœnicopterus?*) which he describes as having green plumage, a white bill and crimson irides and as being smaller than the ordinary pigeon.

He states : " It never settles upon the ground, and when it alights to drink it carries with it a twig which it keeps beneath its feet till its thirst is quenched."

This fanciful notion no doubt owes its origin to the exclusively arboreal habits of the bird.

Mons. de Thevenot[2] who visited India during the reign of the Emperor Aurangzebe, writes : " There are pigeons in that country all over green, which differ from ours only in colour : The Fowlers take them with Birdlime in this manner ; they carry before them a kind of light Shed or Screen, that covers the whole Body and has holes in it to see through ; the Pigeons seeing no man are not at all scared when the Fowler draws near, so that he cunningly catches them, one after another, with a Wand and Birdlime on it, none offering to fly away. In some places Parrocquets are taken after the same manner."

It will be noticed that the method described by the traveller differs little from one in vogue at the present day.

THE PIGEON

The Emperor Akbar was a fervent pigeon fancier, and Abul Fazl informs us[3] he kept more than 20,000 pigeons, divided into ten classes at his court.

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[1] *Ain.*, vol. i, p. 259.

[2] *Travels into the Levant*, published A.D. 1686.

[3] *Ain.*, vol. i, pp. 298–301.

In reference to these pets, Fr. Monserrate writes : " Not a little is added to the beauty of the palaces by charming pigeon-cotes partly covered with rough cast and partly showing walls built of small blue and white bricks. The pigeons are cared for by eunuchs and servant maids. Their evolutions are controlled at will when they are flying, by means of certain signals, just as those of well-trained soldiery are controlled by a competent general by means of bugles and drums. It will seem little short of miraculous when I affirm that when sent out, they dance, turn somersaults all together in the air, fly in orderly rhythm, and return to their starting point, all at the sound of a whistle. They are bidden to perch on the roof, to conceal themselves within their nesting places and to dart out of them again, and they do everything just as they are told."

This flighting of trained pigeons was known as *Ishqbāzi*.

On the subject of these pets, Akbar's chronicler writes:[1] " In former times pigeons of all kinds were allowed to couple ; but His Majesty thinks equality in gracefulness and performance a necessary condition in coupling and has thus bred choice pigeons. The custom is to keep a male and a female pigeon, if not acquainted with each other, for 5 or 6 days together, when they become so familiar that even after a long separation they will again recognize each other." Further : " At the time of departure and breaking up of the camp, the pigeons will follow, their cotes being carried by bearers (*kūhar*). Sometimes they will alight and take rest for a while and then rise again."

Jehangir makes the following observations concerning Carrier Pigeons.[2]

" It had been stated to me in course of conversation that in the time of the Abbaside Caliphs they taught the Baghdad pigeons, who were styled ' letter carriers' (*nāma-bar*) and were one half larger than the wild pigeon. I bade the pigeon fanciers to teach their pigeons and they taught some of them in such a manner that we let them fly from Mandu in the early morning, and if there was much rain they reached Burhanpur by 2½ *pahars* (watches) of the day, or even 1½ *pahars*. If the air was very clear, most of them arrived by one *pahar* in the day and some by 4 *gharis* of the day."

A *ghari* according to Babur was equivalent to about 24 minutes. Four *gharis* would therefore mean 1 hr. 36 minutes. As the crow flies, Burhanpur is about 100 miles S.S.E. of Mandu in the Central Provinces, and this would make the speed of the birds a trifle over 60 miles an hour. According to Thomson [3] a carrier pigeon can keep up 40 miles per hour for a considerable time, but this will be halved against the wind, and nearly doubled with the wind in the bird's favour. It will be noticed at once how very accurate Jehangir is on this point.

Writing some years later, in the reign of the Emperor Shah-Jehan, Manucci states with regard to pigeons:[4] " The Mohomedans are very keen on breeding pigeons in large numbers ;

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[1] *Ain.*, vol. i, p, 299.

[2] *Jeh.*, vol. i, p. 387.

[3] *A Biology of Birds*.

[4] *Storio do Mogor*, vol. i, p. 107.

they make them fly all together, calling out, whistling and waving with a cloth fastened at the end of a stick, running and making signals from the terraced roofs, with a view to encouraging the pigeons to attack the flock of someone else. In this way the flocks are so trained that they fight in the air. Then when the owners whistle and make the signs above described, the pigeons assemble and fly away to their homes, except a few, who losing their way in the confusion, allow themselves in their innocence to be carried along with their adversaries. It is for this end they fly these flocks, and over and over again they send them out to win more pigeons. Every owner is overjoyed at seeing his own pigeons the most dextrous in misleading their opponents."

Manucci further describes a use to which trained carrier pigeons were put by the nobles of Shah Jehan's court which, being a substitute for the modern telephone, is both amusing and ingenious. Says he,[1] "As I have said the Moghuls rear pigeons for amusement, it is necessary for me to inform the reader how they employ these pigeons to give intelligence if the King leaves his house and comes into the public hall to hold audience. Let the reader be aware then, that these nobles are very pleased not to have to move from home uselessly. Many have their dwellings far from the royal palace, about a league away. They order their retinue to be kept in readiness, first of all having sent to court a servant with two pigeons of different colours.

If the King leaves his house or holds audience, the noble's servant releases one of these pigeons at court and by reaching its home it serves as a messenger. If it is the one that denotes the King's leaving home or sitting in audience, the noble at once rides with his cavalcade in all haste to be present as is his duty. If the other comes it notifies the contrary, the retinue are dismissed and the master takes his ease at home."

THE SAND GROUSE

Babur includes in his avifauna what he calls *Baghri-kārā* of Hindustan which, he remarks, "is less than the *Baghri-kārā* of the west and slenderer ; its cry too is sharper."

King suggests that the Indian bird is probably the Common Sandgrouse (*Pterocles exustus*) and the western species to which it has been compared the Black-breasted or Imperial (*P. orientalis*). In the absence of a description of Babur's bird, any conjecture as to its identity is a difficult one. Perhaps King was acquainted with the Turki name of the bird.

THE PEACOCK (*Pavo cristatus*)

Babur writes [2] at some length about this bird. He says : "The peacock is a beautifully coloured and splendid animal ; it is less remarkable for its bulk than for its colour and beauty. Its size may be about that of a crane, but it is not so tall. On the head of the peacock and of the peahen there may be about twenty or thirty feathers rising two or three finger-breadths in height. The peahen is neither richly coloured nor beautiful. The head of the male has a lustrous and undulating colour. Its neck is of a fine azure. Lower down than the neck its back is painted with the richest yellow, green azure and violet; the flowers or stars on its back are but small; below they increase in size, still preserving the same colour and splendour down to the extremity of the tail. The tail of some peacocks is as high as a man. Below the richly painted feathers of its tail it has another smaller tail like that of other birds, and this ordinary tail and the feathers of its side are red. It is found in Bajour and Sawād and in the countries below, but not in the Kūner or Lamghānāt or in any place higher up. It flies even worse than the *karkāwel* (pheasant) and cannot take more than one or two flights at a time. On account of its flying so ill, it either frequents a hilly country or a jungle. It is remarkable that wherever there are many peacocks in a wood, there are also a number of jackals in it, and as they have to drag after them a tail the size of a man, it may easily be supposed (? imagined) how much they are molested by the jackals in their passage from one thicket to another. The Hindustanis call it *moor*. According to the doctrines of Imām Abu Hanīfa this bird is lawful food. Its flesh is not unpleasant: it resembles that of the quail but is eaten with some degree of loathing like that of the camel."

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[1] *Storio do Mogor*, vol. ii, p. 467.

[2] *Babur*, vol. ii, pp. 214–15.

The Emperor would appear to share the modern depreciation of the peacock as a bird for the table though in earlier days it was highly esteemed as such. Classical works contain many allusions to its high appreciation at the most sumptuous banquets, and mediæval bills of fare on state occasions nearly always included it. In the days of chivalry one of the most solemn oaths was taken on "The Peacock" which seems to have been served up garnished with its gaudy plumage.

THE JUNGLE FOWL (*Gallus ferrugineus*)

Babur observes [1] that on the outskirts of the hillocks in Dun—the Jaswan or Una Dun—a fertile valley in the Hoshiarpur District "there are many fowls resembling barn-door fowls; they resemble them in shape but are generally of a single colour."

By "single colour" is presumably meant they were not of different or various colours as is the case with domestic fowls.

The Emperor after mentioning it as one of the common birds of Hindustan describes it thus: "The difference between the *mūrgh-e-sahrā* (or 'fowl of the wild') and the barn-door fowl is that the 'fowl of the wild' flies like a *karkāwel* (pheasant); it is not of every colour like the barn-door fowl. It is found in the hill-countries of Bajour and the hill-countries lower down. It is not met with above Bajour."

Jehangir notes [1] that this jungle fowl was plentiful in the neighbourhood of the fort of Nūrpur [3] where one day he captured

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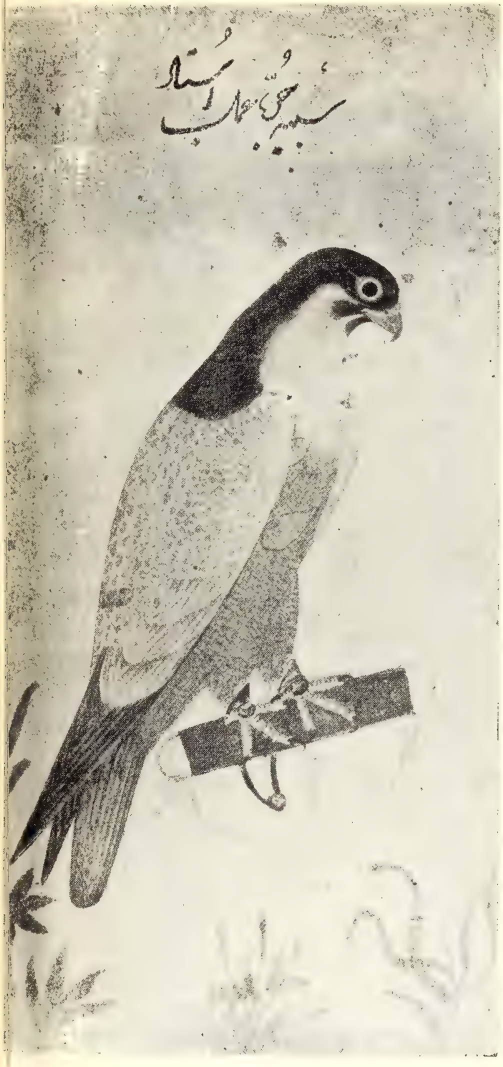
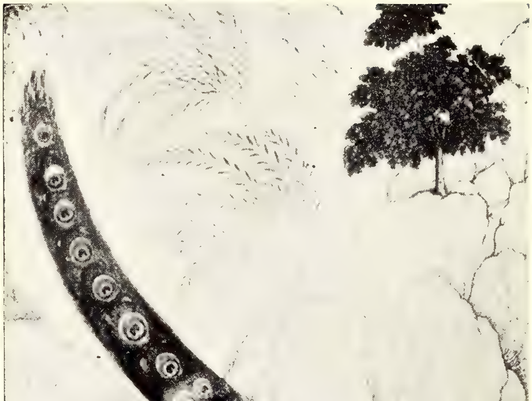
[1] *Babur*, vol. ii, p. 173.

[2] *Jeh.*, vol. ii, p. 226.

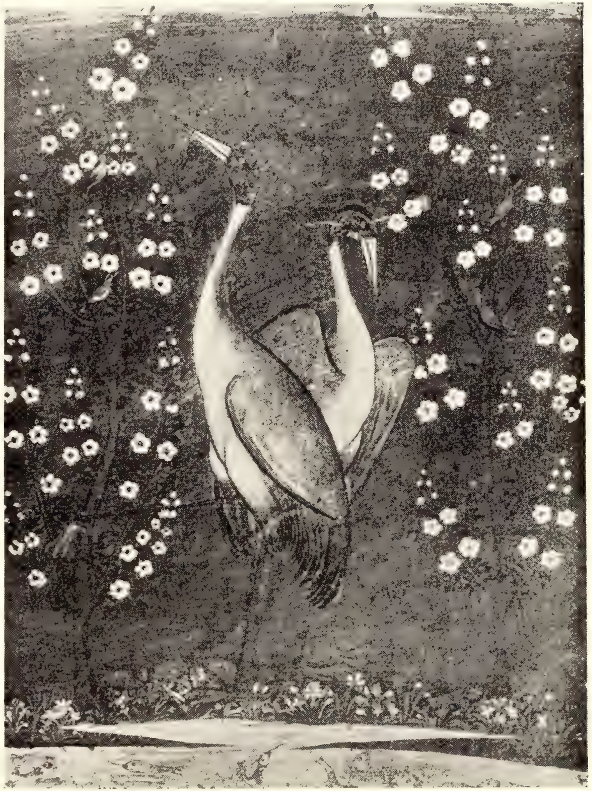
[3] See *Imperial Gazetteer*, new edn., vol. xix, p. 232.



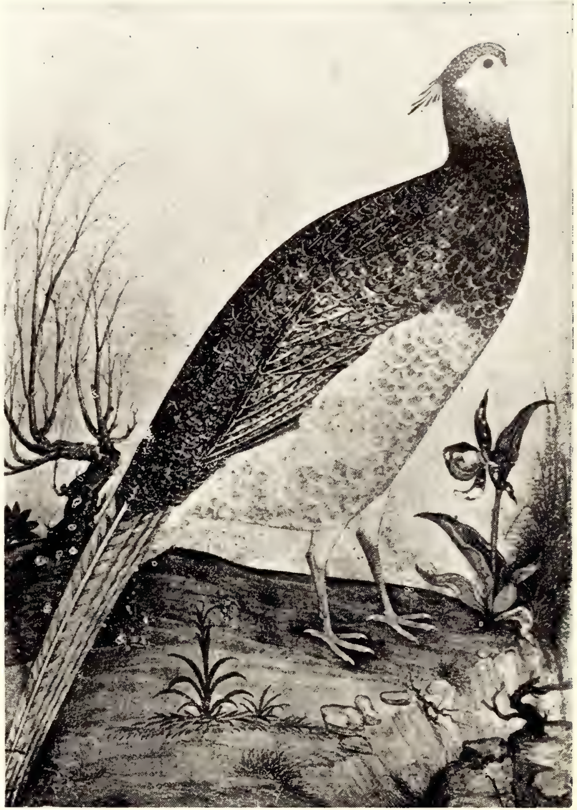
A FALCON.
From a Moghul painting in the Prince of Wales *Museum, Bombay.*)



PEA FOWL.
(Probably painted by Mansur, *c.* A.D. 1625 ; from the collection of Baron Maurice Rothschild, Paris.)
By courtesy of the Publishers ' Indian Painting under the Moghuls '.—Percy Brown.



A PAIR OF SARUS.
(*From a Moghul painting in the Prince of Wales Museum, Bombay.*)



CHEER PHEASANT. (Painted probably by Mansur, *c.* A.D. 1625; collection of Baron Maurice Rothschild, Paris.) *By courtesy of the Publishers, 'Indian Painting under the Moghuls'.—Percy Brown.*

four birds. He says about them: "One cannot distinguish them in shape and colour from domestic fowls. One of the peculiarities of these birds is that if they are caught by the feet and turned upside down wherever they are taken, they make no sound and remain silent contrary to the domestic fowl which makes an outcry. Until the domestic fowl is plunged into hot water its feathers do not come off easily. The jungle fowl like the partridge or *podna* (quail) can be plucked when dry. I ordered them to roast them. It was found that the flesh of the full-grown ones was very tasteless and dry. The chickens had some juiciness, but were not good to eat. They cannot fly farther than a bow-shot. The cock is chiefly red and the hen black and yellow."

PHEASANTS

Jehangir remarks that "Of the wild birds they call *Tadru* (Pheasants) till now it has never been heard that they breed in captivity. In the time of my revered father (Akbar) they made great efforts to obtain eggs and young ones, but it was not managed. I ordered them to keep some of them male and female in one place, and by degrees they bred. I ordered them to place the eggs under hens and in a space of two years 60 or 70 young were produced and 50 or 60 grew up. Whoever heard of this matter was astonished. It was said that in the Vilayet (Persia) the people there had made great efforts, but no eggs were produced and no young were obtained."

Elsewhere Jehangir mentions that a certain Zamindar of Tulwara (which according to Abul Fazl was situated in the Bari Doab Sarkar) brought him a bird which the hill people called *Jān-bahān*. "Its tail" he observes, "resembles the tail of the *qurqāwul* (pheasant) which is also called *tazru* (or *tadru* as above) and its colour is exactly like that of a hen pheasant, but it is half as large again. The circle round the eyes of this bird is red while the orbit of the pheasant is white. The said Basoi (the Zamindar) stated that this bird lived in the snow mountains and that its food was grass and other stuff. I have kept pheasants and have reared young ones and have often eaten the flesh of both young birds and mature ones. One may say that there is no comparison between the flesh of the pheasant and this bird. The flesh of the latter is much more delicate."

The bird referred to in the above narrative is no doubt the Cheer Pheasant (*Catreus wallichi*). One of the vernacular names quoted by Blanford is *Chā mān* which may well be a corruption or variation of Jehangir's *Jān-bahān*. As a bird for the table it may be noted that Blanford considers it far inferior to the Koklass.

The Emperor had a sketch of the bird made at the time. The plate—here reproduced—is said probably to be the handiwork of the celebrated animal painter Al Mansur. Though the picture may appear somewhat stiff and "wooden" if judged from the modern Gronvöldian standard, it leaves little doubt as regards the identity of the species.

THE MONAUL PHEASANT (*Lophophorus impejanus*)

Babur [1] mentions the *Lujeh* or *Lukeh* which bird according to him was also called *Būkalemūn.* It is described as follows : " From the head to the tail it has four or five colours. Its neck has a bright glancing tinge like a pigeon's. Its size may be equal to the *Kabk-e-dūrri* (*Tetrogallus caspius*). It may be regarded as the *kubk-e-dūrri* of Hindustan. As the *kubk-e-dūrri* inhabits the summits of mountains, this also inhabits the tops of mountains. They are met with in the country of Kabul and the hill-country of Nijrau and from thence downward, wherever there are hills, but they are not found any higher up."

In a footnote, Sir Lucas King comments on the above as follows: " This may be the Monaul Pheasant (*Lophophorus impeyanus*), though *Bukalemun* is the Persian word for the turkey. The *kabk-e-dūrri* is much larger than the common *kabk* of Persia and is peculiar to Khorasan—*Tetrogallus caspius.* It is said to be a beautiful bird. The common *kabk* of Persia is the Chukor of India (*Caccabis chukor*)."

The present habitat of this bird, which was till not very long ago common about Mussoorie and Simla, is throughout the Himalayas from Bhutan to Kashmir and even further west. The bird has been recorded from Chitral and from the Safed Koh in Afghanistan. It occurs also in Sikkim.

What Jehangir[2] refers to in the following words may also very probably this bird. He says, " Another bird is of a golden (resplendent ?) colour called in Lahore *Shan.* The Kashmiris call it *Put.* Its colour is like that of a peacock's breast. Above its head is a tuft (*kakul*). Its tail of the width of 5 fingers is yellow, and is like the long feather (*Shāh par*) of the peacock, and its body is as large as that of a goose. The neck of the goose is long and shapeless ; that of this one is short and has a shape."

THE TRAGOPAN (*Tragopan*, sp.)

Babur[3] describes this pheasant as follows : "Another bird is the *Pūlpeikar* (i.e. ' Flower-faced '). Its size is equal to that of the *kubk-e-dūrri* (*Tetrogallus caspius*). Its figure resembles the dung-hill cock, and in colour it is like the hen. From its forehead down to its breast it is a beautiful scarlet colour. The *Phulpeikar* inhabits the hill-country of Hindustan."

Jehangir[4] describes the *Phulpeikar*—one of the birds he saw in the hill-country (of Kashmir)—which the Kashmiris called *Sonlu*, as follows : " It is ⅛ less than a peahen. The back, tail and wings resemble those of the bustard, and are blackish with white spots. The breast to the end of the bosom is black with white spots and some red ones. The ends of the feathers are fiery red and very lustrous and beautiful. From the end of the back of the neck it is also brilliantly black. On the top of its head it has two fleshy horns of a turquoise colour. The skin of its orbits and round its mouth is red. Below its throat there is a skin round it enough to cover the palms of two hands, and in the middle of this the skin is of a violet colour of the size of a hand, with blue spots in the middle. Around it, each streak is of a blue colour, consisting of 8 plumes (?); round the blue streak it is red to the breadth of two fingers like the peach flower, and again round its neck is that blue coloured streak: it has red legs also. The live bird which was weighed came to 152 tolas. (3 lbs. 13 oz.) After it was killed and cleaned it weighed 139 tolas."

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[1] *Babur*, vol. ii, p. 216.

[2] *Jeh.*, vol. ii, p. 220.

[3] *Babur*, vol. ii, p. 218.

[4] *Jeh.* vol. ii, p. 220.

Quails

On this subject Babur says: "The *Budineh* (Quail) is not peculiar to Hindustan, but there are 4 or 5 species of it peculiar to that country. There is one species that visits our countries.[1] It is larger and more spreading than the common *budineh* that visits us. Its wings and tail are reddish. This *budineh* goes in flights like the chir (*Catreus walichii*)." The bird referred to is no doubt the Bush Quail (*Perdicula* sp.).

Babur continues: "There is still another species which is smaller than the *budineh* that visits our country. They are generally black on the throat and breast. There is another species which seldom visits Kabul. It is small, somewhat larger than a *kharcheh* (wagtail). In Kabul they call it *Kuratu*."

The former bird is obviously the Rain Quail (*Corturnix coromandelica*) and the latter may be—it is difficult to say—the Lesser Button Quail (*Turnix dussumieri*). The thoroughness with which Babur has dealt with this family of game birds is apparent, and bespeaks an interest and knowledge possessed only by an exceptionally keen observer.

The See-see Partridge (*Ammoperdix griseigularis*)

Writing from camp at the fort of Rohtas (Punjab) Jehangir notes in his diary as follows:—"At this stage *Tihū* were obtained. The flesh of the *Tihū* is better than that of the *kabk*" (partridge or chukor).

It may be mentioned that *Tihū* is still one of the names by which this little partridge is known in some parts.

The Black Partridge (*Francolinus vulgaris*)

The Emperor Babur refers to this bird as the *Dūrraj*[2] and says "It is not peculiar to Hindustan. It is found everywhere in the countries of the Garmsil[3] but as certain species of it are found only in Hindustan, I have included it in this enumerative description. The partridge may be equal to the *kabk-e-dūrri* in size.[1] The colour of its beak is like that of the female of the *mūrgh-e-dashti* (Jungle Fowl). Its neck and breast are black, with white spots. On both sides of both its eyes is a line of red. It has a cry of *shīr-dārem-shakrek* ('I have milk and a little sugar'). From its cry it gets its name. It pronounces *shir* short, *dārem-shakrek* it pronounces distinctly. The colour of the hen resembles that of a young *karkāwel* (pheasant). They are found below Nijrau."

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[1] i.e. the countries north of the Oxus. As suggested by King, this migratory species may probably be the Common Grey Quail (*Coturnix coturnix*). *Babur*, vol. ii, p. 219, footnote.

[2] According to Mrs. Beveridge, *Dūrraj* in Arabic means "one who repeats what he says"; a "tell-tale."

[3] Afghanistan

Jehangir records having met this bird in the stony country near the village of Bakkar (Sind) in the course of one of his periodical marches to Kashmir about the year A.D. 1620.

THE GREY PARTRIDGE (*Francolinus pondicerianus*)

What appears very likely to be this bird is described by Babur thus :—" There is another kind of fowl of the partridge kind which they call *kanjel.* It is about the size of a *kabk.* Its cry is very like that of a *kabk* (chukor) but shriller. There is little difference in colour between male and female. It is found in the country of Peshawar, Hashnagar and in the countries lower down but in no higher district."

Abul Fazl mentions that partridges in Kashmir afforded good sport. They were probably hunted with hawks—a form of sport which is still extremely popular in Hindustan.

Jehangir relates that one day while hunting, he saw a *tuyghun* or albino partridge such as he had never before seen, which he caught with a hawk that likewise happened to be an albino. He[2] continues : "I ascertained by trial that the flesh of the black partridge (ordinarily coloured ?) was better than that of the white. . . . "

THE CRANE

Jehangir describes a *Kulang*[3] hunt with falcons, a sport, he states, of which his son Shah Jehan was particularly fond. The birds employed on this occasion were *Shāhīn* (either *Falco peregrinator* or *F. barbarus*) He relates : " At Shah Jehan's request I rode out early in the morning and caught one *dūrna* (crane) myself whilst a falcon my son had on his wrist caught another. Certainly of all good hunting amusements this is the best. I was exceedingly pleased with it. Although the Sarus is large, it is lazy and heavy on the wing. The chase of the *dūrna* has no resemblance to it. I praise the heart and courage of the falcon that can sieze such strong bodied animals, and with the strength of his talons subdue them. Hassan Khan, chief huntsman of my son was honoured with an elephant, a horse and a dress of honour as a reward for his exhibition of sport, and his son also received a horse and a dress of honour."

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[1] Apparently here only *kabk* (chukor) is meant, as we have been told above that the *kubk-e-dūrri* is the size of the Monal Pheasant.

[2] *Jeh.*, vol. ii, p. 284.

[3] Either *Grus communis* or *Anthropoides virgo*.

The Emperor records[1] that once while hunting waterfowl in Kashmir, a boatman caught and brought him a young Demoiselle Crane (?)

" It was very thin and miserable " continues the royal naturalist, " It did not live longer than a night. The *qarqarā* (Demoiselle Crane ?—perhaps from its cry) does not live in Kashmir. This had became ill and thin at the time of coming from, or going to Hindustan and had fallen there."

The last passage would tend to indicate that the Emperor was well acquainted with the fact of bird migration.

THE SARUS CRANE (*Grus antigone*)

Babur[2] describes this bird as follows : " The Turks who are in Hindustan call the Sarus *Tiweh tūrneh* (Camel crane). It is a little less than the *ding* (Adjutant). Its head is red. They keep it about their houses and it becomes very tame."

Jehangir appears to have entertained a special regard for this bird, concerning which his observations and notes are particularly exhaustive. The reputed devotedness of the pair to one another and their attachment to their young seems to have particularly arrested his fancy. He relates that once when encamped in the neighbourhood of Deogaon (Gujerat) one of his eunuchs caught two young sarus on the bank of a large tank hard by. " At night " he notes, " two large sarus appeared making loud cries near the *ghusal khana* (lit. ' Bath chamber ') which they had placed (erected) on the edge of the tank, as if somebody were exercising oppression on them. They fearlessly began their cries and came forward. It occurred to me that certainly some kind of wrong had been done to them, and probably their young had been taken. After enquiry was made, the eunuch who had taken the young sarus brought them before me. When the sarus heard the cries of the young ones, they without control threw themselves upon them, and suspecting they had had no food, each of the two sarus placed food in the mouths of the young ones and made much lamentation. Taking the young ones between them, and stretching out their wings and fondling them, they went off to their nest."

The Emperor has recorded some extremely useful and interesting notes concerning the breeding habits of the sarus, from pairing onwards, to the time the young were hatched, which I think deserve to be quoted *in extenso*. They bespeak the keen and lively interest of the writer in his subject, and their minuteness and accuracy are such as would do justice to any modern work on Natural History.

He writes :[3] " At this time the pairing of the sarus which I had never before seen, and is reported never to have been seen by man, was witnessed by me. The sarus is a creature of the crane genus, but somewhat larger (*dah dūwazdeh*, lit., ten, twelve, i.e. its is $\frac{1}{5}$ larger). On the top of the head it has no feathers, and the skin is drawn over the bones of the head.

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[1] *Jeh.*, vol. ii, p. 176. [2] *Babur*, vol. ii, p 220.
[3] *Jeh.* vol. ii, p. 16.

From the back of the eye to six fingers breadths of the neck it is red. They mostly live in pairs on the plains, but are occasionally seen in flocks. People bring a pair from the fields and keep them in their houses and they become familiar with men. In fact there was a pair of sarus in my establishment to which I had given the names of Laila and Majnun (the 'Romeo and Juliet' of Persian story and song). One day a eunuch informed me that the two had paired in his presence. I ordered that if they showed an inclination to pair again they should inform me. At dawn he came and told me that they were about to pair again. I immediately hastened to look on. The female having straightened its legs, bent down a little : the male then lifted one of its feet from the ground and placed it on her back, and afterwards the second foot, and immediately seating himself on her back paired with her. He then came down, and stretching out his neck, put his beak on the ground and walked once round the female. It is possible they may have an egg and produce a young one. Many strange tales of the affection of the sarus for its mate have been told. The following case has been recorded because it is very strange. Qiyam Khan, who is one of the *Khanzadas* (house-born ones) of this court, and is well acquainted with the arts of hunting and scouting, informed me that one day he had gone out to hunt and found a sarus sitting. When he approached, it got up and went off. From its manner of walking he perceived signs of weakness and pain. He went to the place where it had been sitting. He threw a net round it and drew himself into a corner, and it tried to go and sit in the same place. Its foot was caught in the net and he went forward and siezed it. It appeared extremely light, and when he looked minutely he saw there were no feathers on its breast and belly ; a handful of feathers and bone came into his hand. It was clear that its mate had died, and that it had sat there from the day it lost its companion. Himat Khan, who is one of my best sevants, and whose word is worthy of reliance, told me that in the Dohad Parganna (Gujerat) he had seen a pair of Sarus on the bank of a tank. One of his gunners shot one of them and in the same place cut off his head and stripped it of its feathers. By chance we halted two or three days at that place, and its mate continually walked round it and uttered cries of lamentation. 'My heart,' he said, 'ached at its distress but there was no remedy for it save regret.' By chance, twenty-five days afterwards he passed by the same spot and asked the inhabitants what had become of the sarus. They said it died on the same day and there were still remains of feathers and bones on the spot. He went there himself and saw it was as they said. There are many tales of this kind among the people which it would take too long to tell."

A few days later, Jehangir continues his diary : ". . . . the sarus, pairing of which has been related in the preceding pages, collected together some straw and a little rubbish in the little garden and laid first of all one egg. On the third day after this it laid a second egg. This pair of sarus were caught when they were about a month old and had been in my establishment five years. After 5½ years they paired and continued doing so for a month ; on the

21st of the month of Amurdad, which the Hindus call Savan (*Shravan*: August-September) the hen laid the eggs. The female used to sit on the eggs the whole night alone, and the male stood near her on guard. It was so alert that it was impossible for any living thing to pass near her. Once a large weasel (mungoose) made its appearance and he ran at it with the greatest impetuosity and did not stop till the weasel got into a hole. When the sun illuminated the world with its rays the male went to the female and pecked her back with his beak. The female then rose and the male sate in her place. She returned and in the same manner made him rise and seated herself. In short the female sits the whole night and takes care of the eggs and by day the male and female sit by turns. When they rise and sit down, they take great precautions that no harm shall come to the eggs.'

The Emperor continues his observations as follows: "From Sunday 3rd till the eve of Thursday the 7th rain fell. It is strange that on other days the pair of sarus sate on the eggs five or six times in turns, but during this 24 hours when there was constant rain and the air was somewhat cold the male, in order to keep the eggs warm, sate from early in the morning till mid-day, and from that time till the next morning the female sat without an interval for fear that in rising and sitting again, the cold air should affect them and the eggs become wet and be spoilt. Briefly, men are led by the guidance of reason, and animals according to Divine Wisdom implanted in them by Nature. Stranger still is it that at first they keep their eggs together underneath their breast, and after 14 or 15 days have passed they leave a little space between them for fear that the heat should become too great from their contact with each other. Many become addled in consequence of (too great) heat."

Further, "On the eve of Thursday the 21st the sarus hatched one young one, and on the eve of Monday the 25th a second; that is, one young was hatched after thirty-four days and the other after thirty-six days (from the time the first egg was laid or also thirty-four days for this). One might say that they were $\frac{1}{10}$th larger than the young of a goose, or equal to the young of a peafowl at the age of a month. Their skin was of a blue colour. On the first day they ate nothing and from the second day the mother taking small locusts (grasshoppers) in her mouth sometimes fed them like a pigeon, or sometimes like a fowl threw them before them to pick up of themselves.

If the locusts were small it went off well, but if they were large she sometimes made two or three pieces of it so that the young ones might eat it with ease. As I had a great liking for seeing them I ordered them to be brought before me with every precaution that no harm might happen to them. After I had seen them I ordered them to be taken back to the little garden inside the royal enclosure, and to be preserved with the greatest care, and that they should be brought to me again whenever they were able to walk."

The diary continues a few days later: " . . . . At first the male sarus used to hold its young one by its leg upside down in its beak, and there was a fear that he may be unkind to it and it might be destroyed. I had accordingly ordered them to keep the male separately and not allow it near its young ones. I now ordered by way of experiment that it should be allowed near them, that the real degree of its unkindness or affection might be ascertained. After allowing it, it displayed much attachment and kindness, and his affection was found to be no less than that of the female. I thus knew that this performance was out of real love.''

Further on, the following entry made at Agra (?) appears: "The pair of sarus that had had young ones had been brought from Ahmedabad on Thursday the 25th. In the court of the royal enclosure which had been placed on the bank of a tank, they were walking about with their young ones. By chance both the male and the female raised a cry and a pair of wild sarus hearing it, and crying out from the other side of the tank, came flying towards them. The male with the male and the female with the female engaged in a fight and although some people were standing about the birds paid no heed to them. The eunuchs who had been told off to protect them hastened to sieze them. One clung to the male and the other to the female. He who had caught the male kept hold of it after much struggling, but the one who siezed the female could not hold her and she escaped from his hand. I with my own hand put rings in its beak and on his legs and set him free. Both went and settled in their own place; whenever the domestic sarus raised a cry they responded.''

THE GREAT INDIAN BUSTARD (*Choriotes edwardsi*)

"The *Kharchal*" (or Bustard) according to Babur 'which may be about the size of a *tughdak* is in reality the *tughdak* of Hindustan. Its flesh is very savoury. The flesh of the leg of some fowls and of the breast of others is excellent; the flesh of every part of the *kharchal* is delicious.''

The real *tughdak* it would appear is the Great Bustard (*Otis tarda*) with which Babur seems familiar from his Central Asian home. The Indian bird above referred to is no doubt the Great Indian Bustard, which in some parts of India is known as *Tughdar* or *Tuqdar*, a possible corruption of the original *tughdak*, as suggested by King.

THE FLORICAN

Babur says:[1] "The size on the *Charz* is somewhat less than a *tughdari*. The back of the male is like that of the *tughdari*; its breast is black. The female is of a single colour. The flesh of the *charz* is very delicate. As the *kharchal* resembles the *tughdak*, the *charz* resembles the *tughdari*.''

This bird can be either the Likh or Lesser Florican (*Sypheotis auritra*) or the Bengal Florican (*Sypheotis bengalensis*). Most probably, however, the reference is to the latter species as it seems hardly credible that the peculiar elongated feathers of the upper throat and ear coverts of the former bird, should have escaped mention at the hands of a keen naturalist like Babur. From the fact that no description of the *tughdari* is furnished it may be concluded that this bird also (undoubtedly the Houbara—*Chlamydotis undulata macqueeni*) was familiar to the Emperor and his readers at home.

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[1] *Babur*, vol. ii, p. 219.

Writing of this bird, Jehangir [1] says: "I formerly thought that there were two species, one a mottled black and the other *bur* (a kind of dun colour). I now discovered that there are not two kinds but that which is a mottled black is the male and that which is dun coloured is the female. The proof is that in the piebald there are testicles and in the dun one there are eggs (ovaries). This has repeatedly been found on examination."

Jehangir's personal research is laudable, but it seems strange that though Babur recognized at first that "the female is of a single colour" his naturalist great-grandson should have made this discovery only at a comparatively late stage.

The Emperor further observes as follows: "It is a strange thing that the windpipe in all animals (*haiwanat*) which the Turks call *hulq*, is single from the top of the throat to the crop (*china-dan*), while in the case of the *charz* it is different. In this case it is four fingers breadths from the top of the throat single and then it divides into two branches and in this form reaches the crop. Also at the place it divides into two branches there is a stoppage (*sar-band*), and a knot (*girih*) is felt by the hand."

I do not know what peculiarity Jehangir is referring to. I can find no mention anywhere of anything extraordinary in regard to this part of the florican's anatomy.

THE WHITE IBIS (*Ibis melanocephala*)

Another bird, which Babur calls the White Buzek, is no doubt this species. Its Hindi name is *Safed baza*. The Emperor says: "Its head and bill are black. It is considerably larger than the *buzek* of our country[2] but less than the *buzek* of Hindustan."[3]

Another species of Ibis is also described by Babur which I am unable to place.

THE WHITE-NECKED STORK (*Dissoura episcopa episcopa*)

Babur [4] observes: "There is another sort of stork which has a white neck while the head and all the rest of its body are black. It migrates to our countries. It is rather less than the common stork. This stork the Hindustanis call *Yakding*."

King suggests that this may be the Painted Stork (*Pseudotantalus leucocephalus*). I do not see precisely what justification he has for doing so, as the description appears to fit this species much better though it must be admitted that the underparts of our bird have a considerable amount of white in them.

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[1] *Jeh.*, vol. ii, p. 292.

[2] Which according to Mrs. Beveridge may be *Plegadis falcinellus*, the Glossy Ibis, a winter visitor to most parts of India.

[3] King suggests that by this last may be meant the Spoonbill (*Platalea leucorodia*) called in India *Chamach-buzek*.

[4] *Babur*, vol. ii, p. 220.

THE ADJUTANT STORK (*Leptoptilus dubius*)

Babur[1] writes: " One of the fowls that frequent the water and banks of rivers in the *Ding*, which is a large bird. Each of its wings is the length of a man; on its head and neck there is no hair. Something like a bag hangs from its neck; its back is black, its breast white; it frequently visits Kabul. One year they caught and brought me a *ding* which became very tame. The flesh which they threw it, it never failed to catch in its beak, and swallowed without ceremony. On one occasion it swallowed a shoe well-shod with iron: on another occasion it swallowed a good sized fowl right down, with its wings and feathers."

The Emperor also records the popular superstition, prevalent even in his day, that if you split the head of an Adjutant before death, you will extract from it the celebrated *Zahir mohra* (Poison-killer) or " Snake stone " of great virtue and repute and a potent antidote against all kinds of poison.

THE PAINTED STORK (*Pseudotantalus leucocephalus*)

Babur describes this bird as " nearly the height of a sarus, but its size is less. It resembles the stork (Lalag—*Ciconia alba*) but is much larger. Its bill is longer than a sarus's and black. Its head is polished and shining, its neck white, its wings parti-coloured. The edges and roots of the feathers of its wing are white and the middle black."

Both King and Mrs. Beveridge are of opinion that this may be the White-necked Stork (*Dissura episcopa*). From the clue however that its head is " polished " (although the bill certainly is not black) it is possible that the Painted Stork is meant. Babur is unmistakably clear in other places when describing shine or gloss of feathers (cf. Pigeon and Monal Pheasant) and the word rendered as " polished " by the translators would appear to indicate the bare facial skin of this bird which extends back to the crown. The description of the plumage, moreover, points more to its identity as this rather than to the species suggested by King and Mrs. Beveridge. Babur called the bird *Minkisa*.

THE OPEN BILL (*Anastomus oscitans*)

The bird described by Babur as follows may be this species: " It resembles in colour and shape the stork that visits our countries. Its beak is generally black and white, and is much smaller than the other."

EGRETS

In view of much recent interest and the proposed legislation for licensing egret farms in Sind and elsewhere so as to make it a commercially profitable industry without detriment to the birds producing the plumes, it is interesting to read Abul Fazl's account[2] relating to the Sarkar of Kashmir where he says: " In the village of Matalhamah is a wood which is a heronry. The heronries are strictly guarded and in the Spring when their long feathers fall from their necks, there is a watchman in attendance who picks them up. The feathers are taken for plumes and the birds here are regularly fed."

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[1] *Babur*, vol. ii, p. 220.

[2] *Ain.*, vol. ii, p. 362.

Jehangir remarks that " among the excellencies of Kashmir are the plumes of feathers (*kalgi*) " presumably from these very heronries, " of which as much as 10,700 feathers are yearly obtained."

THE NUKTA OR COMB DUCK (*Sarcidiornis melanonotus*)

Babur's *Shah-mūrgh* described as follows, is obviously this duck. " There is another waterfowl which they call *Shah-mūrgh*. It may be rather less than a goose. It has a swelling above its nose. Its breast is white, its back black and its flesh is excellent."

THE SPOT-BILLED DUCK (*Anas pœcilorhyncha*)

Babur describes a species of duck as follows : " There is a waterfowl which they call *Gheret-pai*. It is larger then the *Sona-burchin*. The male and female are of the same colour. It is always found in Hashnagar and sometimes visits the Lamghanat. Its flesh is very delicate."

In a footnote, Sir Lucas King suggests that this may be the Spotbilled Duck, which is called *Garm-pai* by the falconers. *Sona* according to him is the name for the Mallard. Mrs. Beveridge in her translation of Babur's *Memoirs*, renders the word as *Gharm-pai* and remarks that Dr. Ross' notes from the " Sanglakh " that *Suna* is the drake and *Burchin* the duck of *Anas boscas*, and that it is common in China to call a certain variety of bird by the combined sex names. This practice, it may be mentioned, is frequently adopted in India also, thus *Chakwa-chakwi* is the name by which the Brahminy Duck (*Casarca rutila*) goes in many parts of the peninsula.

(*To be continued*)

THE BIRDS OF BRITISH BALUCHISTAN

BY

CLAUD B. TICEHURST, M.A., M.R.C.S., M.B.O.U., F.R.G.S.

PART III

(*With a plate*)

(*Continued from page 881 of Volume XXXI*)

Tyto alba javanica (Gmel.) The Indian Barn Owl.

Murray says he obtained the White Owl at Siri Bolan in the Pass on May 18, 1880. W. D. Cumming informed me that one was seen about the Telegraph Station at Ormarra for a week in March 1902. No other record. Possibly a rare resident.

Asio otus otus (L.) The Long-eared Owl.

The Long-eared Owl is a rare vagrant in the north ; one was obtained at Quetta on December 2, 1908 and Murray records it also from the Quetta Valley. Hutton and St. John both obtained it at Kandahar.

Asio flammeus (Pont.) The Short-eared Owl.

A winter visitor in small numbers, the Short-eared Owl has been obtained on several occasions in the Quetta Valley, Mach, Gulistan and Fort Sandeman between January 10 and April 21.

In the Mekran Hotson met with it twice, in the Hingol Valley on September 3 and at Dizak on November 18 ; probably scarce. I saw one on the Sind side of the Habb River on November 14.

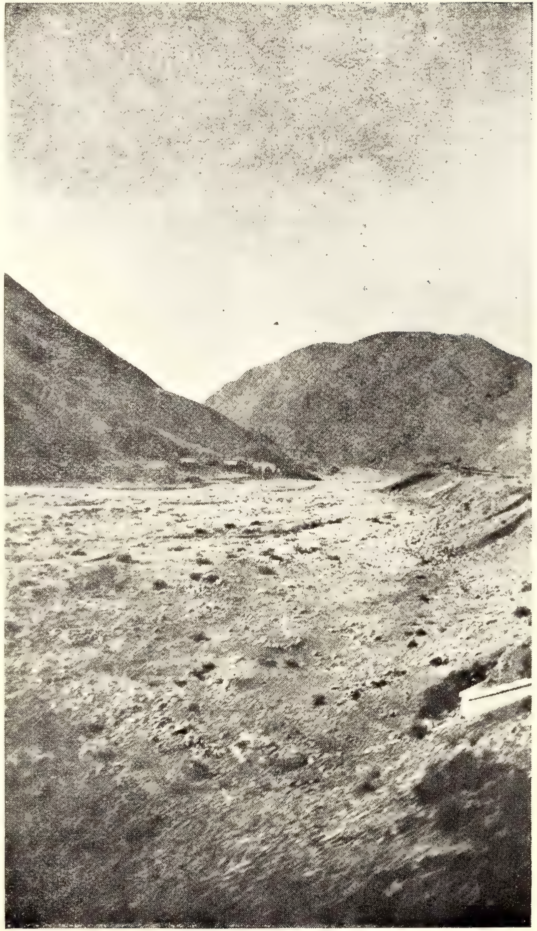
Strix aluco biddulphi, Scully. Scully's Wood Owl.

Col. Venning obtained this owl on January 10, at Old Shinghar in the Zhob Valley ; the specimen is in the Bombay Museum. No other record. ? Rare resident in extreme N.E.

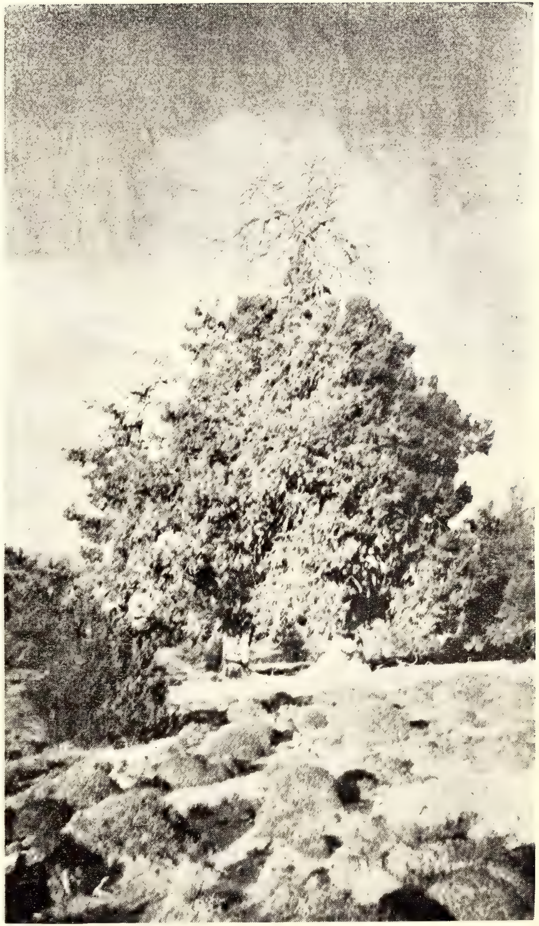
Strix butleri (Hume.) Hume's Owl.

The type of the species was collected in Mekran by Nash for Butler ; it is in the British Museum. Nash was for many years stationed at Ormarra and so possibly this bird came from there.

This Owl, which was described by Hume in 1878, has never been met with there since. There is in the Liverpool Museum an earlier bird obtained by Claude Wyatt in Sinai in 1864. In the *Ibis* 1870 Wyatt no doubt refers to this Owl as *Phasmoptynx capensis ;* he says one of his men was working at the ruins of Feiran when he saw this owl looking out of a hole in the wall and by closing the hole with a stone he captured it. This was the only specimen Wyatt got though he heard what was apparently this species in the Wadi Hebran and 'perhaps half a dozen times in the Peninsular.' This was in January. In September 1911 Schrader heard this owl in the Wadi Feiran and on the 23rd obtained one which was so blown to pieces that only parts, just sufficient for identification, could be preserved. A fourth example was obtained by Philips in the Wadi Feiran on March 31, 1914. (*The Auk*, 32, p. 282 and plate). Probably too it was this Owl which Kaiser got in August 1891 and July 1892 in the Wadi Bedr and in the Wadi Arka on March 31, 1893. (*Le Roi Jour. f. Orn.*, 1923, pp. 65–66). It seems clear then that this Owl's home is the Sinai peninsula where it is evidently not uncommon though perhaps very local and that it is resident there. How comes it then that Nash got it on the Mekran coasts ? ; it seems unlikely that it is a normal resident there. Cumming tried at various places there for years and did not come across it and other naturalists—Blanford, Zarudny, Zugmayer, Hotson—all failed to meet with it. If it is very local and also very scarce it yet may have possibly eluded all these people. On the



HANNA PASS, QUETTA.
BARE HILLS BELOW JUNIPER LEVEL, A FAVOURITE RESORT OF *Calandrella acutirostris*.



A VENERABLE JUNIPER. ZIARAT FOREST.

other hand cyclones occur sometimes on this coast and bring birds which are not usually met with and this may account for its occurrence but even then one must suppose it occurs somewhere in Arabia nearer than Sinai. Unfortunately there are no details of the capture of this bird at Ormarra.

Bubo bubo turcomanus (Evers.) The Turkestan Eagle Owl.

'Boom', Bal.

The Eagle Owl is resident and sparsely distributed in the hills of N. Baluchistan. Marshall received a young one taken from the nest and there are two half grown young in the Quetta Museum taken near there on June 3, 1915, where there are also three adults. It has been obtained at Khozdar in S. Kalat and at Kandahar. Besides those in Quetta Museum I have examined three in the British Museum obtained at Quetta, Kandahar, and Kalat and they appear to be typical *turcomanus* which is very near *ruthenus*—W. 450–460 mm.

Neither *Bubo bengalensis* nor *Bubo coromandus* are recorded from Baluchistan but I have seen the former between Karachi and the Baluch boundary.

Otus scops pulchellus (Pall.) The Eastern Scops Owl.

The distribution and status of the three species of Scops Owl is not clear and there are very few records of any of them. It seems fairly clear however that this Scops Owl is a summer visitor in small numbers and locally distributed in N. Baluchistan. It apparently arrives about the middle of April. St. John says it is common in the juniper hills and Swinhoe records it (as *pennatus*) in the orchards at Kandahar. I have examined specimens obtained at Chaman on April 16, at Kandahar on April 11 and 12 and a half-grown young one from Ziarat on July 2. Murray records this bird in several places between Quetta and Kandahar and says *pennatus* (rectius *sunia*) occurs at Mach, Dozan and Quetta, however there are no specimens to bear this out or that the Indian Scops Owl occurs at all in Baluchistan.

The only record from the south is from Ormarra on the coast where Cumming obtained one on passage in September.

Otus brucei (Hume.) The Striated Scops Owl.

The Striated Scops Owl must be resident (or a summer visitor) in small numbers. I have seen one (in British Museum) from Chaman obtained on April 23 and also a half-grown young one from the same place on June 6. These are the birds recorded by Barnes and St. John. One from Toba Achahzai obtained in June is in the Bombay Museum and W. D. Cumming sent me a full grown young one from Sheik Mandah on August 16, 1923.

In Central Mekran Hotson obtained one at Shireza Patk (Kharan) on the Panjgur-Kalat road.

Otus bakkamœna deserticolor (Ticehurst.) The Desert Collared Scops Owl.

The only certain record is a bird obtained by Murray (now in British Museum) at Killi Abdullah (5,100 ft.) on the road from Quetta to the Khojak on May 3, 1880, where it must have been breeding.

Scops Owls (? this) are said to occur in Las Belas.

Athene brama indica (Frankl.) The Indian Spotted Owlet.

Meinertzhagen obtained two specimens at Quetta on April 6 and June 7. Swinhoe says it is common in the lower parts of the Bolan but he did not find it west of Mach ; he obtained an adult and a young bird at Pir Chowki at the entrance on May 15. Murray, on the other hand, says it is found as far as Gulistan and is replaced beyond the Khojak by *bactriana*. The distribution is not quite clear but it can be safely said that this owl comes up as far as Quetta where it breeds and is resident. Common at Sibi in the plain.

It is fairly common throughout the Makran in suitable places and is resident ; it occurs as far west as Bampur in Persian Baluchistan and Hotson obtained it far as north in the Makran as Gajar in the Mashkai valley.

Athene noctua bactriana (Hutton.) Hutton's Little Owl.

The Little Owl is fairly common and resident over the whole of N. Baluchistan inhabiting banks, rocks, old walls, etc. Barnes records young in a hole in a tree on June 3 at Chaman while at Kandahar Swinhoe found several nests with young in the fort walls early in April. I have examined numerous adults and young in the Quetta Museum obtained in that district. It apparently does not occur in the Bolan, and it is curious that St. John does not refer to it in

Kalat as it certainly occurs, as Hotson obtained it at Surab in S. Kalat on July 1.

In the Makran there are no records of it but Hotson obtained it at Magas just over the Persian boundary on December 3, where he says it was scarce.

Pandion haliaëtus haliaëtus (L.) The Osprey.

It is remarkable that there is no record of the Osprey in N. Baluchistan. On the Makran coast it is common enough in winter and according to W. D. Cumming it is found throughout the year but he had no evidence of its breeding there, though there is no reason why it should not do so in such places as Ormarra Head, as it certainly breeds at the eastern end of the Persian Gulf. On the other hand non-breeding birds may be seen on the Sind coast all through the hot weather.

Ægypius monachus (L.) The Cinereous Vulture.

The Black Vulture is resident in small numbers throughout the higher hills of the north (8,000–10,500 ft). The huge nest is nearly always built in the top of a large juniper, a single egg in March or early April is laid, though a much incubated egg is recorded in May. In winter it spreads out to the lower plains and valleys and so reaches Sibi and Kandahar.

It wanders to the Makran coast where Cumming has noted it in the hills near Ormarra but its status in S. Baluchistan is not known.

Gyps fulvus fulvescens (Hume.) The Griffon Vulture.

The earlier writers considered the Griffon to be less common than the Black Vulture but the concensus of opinion now seems to be that it is the commoner of the two in N. Baluchistan. It is resident and breeds at the higher elevations. Betham records an egg on April 5 and Marshall one young hatched on April 25. It is a cliff breeder. During the Afghan War of 1879 Swinhoe noted that vultures became much commoner than before.

Probably a winter visitor to the Makran coast; Cumming has noted it at Ormarra; status elsewhere not known, but almost certainly breeds in the Khirthar Range.

Gyps himalayanus (Hume.) The Himalayan Griffon Vulture.

A bird in Quetta Museum obtained at Quetta on February 10, appears to be a young bird of the species. A wanderer?

Pseudogyps bengalensis (Gmel.) The Indian White-backed Vulture.

St. John records that in 1878 the White-backed Vulture followed the troops marching from Sukkur to Afghanistan, profiting by the numerous dead animals left *en route*. The laying of the railway across the Sibi plain in 1879 depriving them of food on the first part of the journey, they disappeared. Murray however records it at both ends of the Bolan Pass in 1880. There are no recent records of this 'Plains' bird, nor did I meet with it even at Sibi in December.

It wanders to the Habb Valley doubtless from Karachi where it is common and may go further into Las Belas but I have no record of it from anywhere else in Makran; but Zarudny lists it as a breeding species in Persian Baluchistan.

Neophron percnopterus percnopterus (L.) The Egyptian Vulture.

The Neophron is a very common summer visitor to the hills of N. Baluchistan arriving at the beginning of March. It appears to breed all through the higher hills; young are recorded as hatched at the end of April and both cliffs and trees are utilized as nesting sites. The birds have left the hills by September and young appear in the Quetta valley by the end of July, in which locality and others of similar altitude some birds may be seen into November. It is common in the Sibi plain in winter.

Throughout Central and Coastal Makran it is probably more or less resident; it breeds round Ormarra in March making its nest usually on a ledge near the top of the lower hills and difficult of access; fresh eggs were found by Cumming on March 1 and March 31.

Zarudny and Härms described the Neophron from S. Persian Baluchistan as *N. percnopterus rubripersonatus* (Orn. Monats., 1902, p. 52) differing from the typical race in having the bare parts of the head orange-red instead of yellow. W. D. Cumming who found Neophrons common at Charbar in 1920 paid particular attention to this point at my request and sent me a description and water colour painting of birds examined at close quarters and he added that he could see no difference between these Charbar birds and Karachi ones, and judging by the painting and description I agree. He never saw any with orange-red on the head. Zarudny's race cannot be, I think, a good one and must be founded on stained birds.

Gypaëtus barbatus grandis Storr. The Lammergeier.

One of the ornithological sights of N. Baluchistan is the quantity and tameness of the Bearded Vultures. It is a constant resident and breeds in all the higher hills from the Suleimans westward. It lays early in March, the nests being on ledges of (mostly) inaccessible cliffs. It is common in the Bolan Pass but does not reach the Sibi plain. Round Quetta it is distinctly a scavenger and attends at carcasses with Neophrons and ravens and may be seen often enough right in the Cantonment swooping round low down in search of morsels; Meinertzhagen records attempts of one to carry off a puppy from a barrack room verandah! At Ziarat, too, I have had this magnificent bird sailing round within few feet of my head.

Not recorded in central and coastal Makran.

Aquila chrysaëtus daphanæ (Menzb.) The Golden Eagle.

Locally in the higher hills of N. Baluchistan the Golden Eagle is not uncommon and is resident, wandering to the lower valleys in winter. At Ziarat in the autumn one or two of these magnificent birds were seen almost daily soaring high overhead. Radcliffe records that a young one taken from an eyrie was sent to the Karachi Zoo and that he received an egg taken by natives which was thought to be of this species. Marshall too had eggs brought to him and saw an eyrie and obtained an adult. They hunt in pairs for Chukar and readily take wounded birds; Meinertzhagen records that one even swooped on a covey and took a bird on the wing. In the Quetta Museum are specimens from Quetta on January 29, and Harboi August 30 and I have a young one just out of the nest picked up dead near Quetta in my collection.

No record in S. Baluchistan for I am doubtful if the bird recorded by Hume at Gwader on February 18 could belong to this species.

Aquila heliaca (Savigny.) The Imperial Eagle.

Swinhoe records the Imperial Eagle as common in winter at Kandahar whence there are specimens in the British Museum; it is therefore rather surprising that there are no records of it in Baluchistan except Murray's statement that Dupuis collected several at Quetta on May 2, 1880 and July 7, 1888.

Aquila nipalensis nipalensis (Hodg.) The Steppe-Eagle.

Hotson obtained a Steppe-eagle at Hazarganji in the valley of the Dhor (Hingol R.) Jhalawan on September 19.

No other record; scarce winter visitor?

Aquila rapax vindhiana (Frankl.) The Indian Tawny Eagle.

Meinertzhagen records that the Tawny Eagle is not uncommon in the plains of N. Baluchistan between February and September; a local specimen obtained on July 22 is in the Quetta Museum.

Hotson obtained one at Gidar in S. Kalat on June 29; I have seen it in the Habb Valley in June and Cumming says it is occasionally seen at Ormarra from October to May. How much further west it occurs is not known. Nor is its status clear; Zarudny lists it as nesting in Persian Mekran.

Aquila clanga (Pall.) The Greater Spotted Eagle.

The Spotted Eagle should be commoner than records indicate. Murray records it at Siriab in March, at Nuskhi and at Kirta on May 22! Cumming obtained one at Ormarra on October 29.

No other records.

Hieraëtus fasciatus (Vieill.) Bonelli's Eagle.

Bonelli's Eagle is doubtless resident in small numbers throughout Baluchistan. Marshall records nests in the Quetta district with one egg on May 14 and with two eggs on May 26. Meinertzhagen noted several at Ziarat in July.

Cumming informed me that it is resident at Ormarra on the Mekran coast and breeds there in January whence there is a specimen in Bombay Museum.

Hieraëtus pennatus (Gmel.) The Booted-Eagle.

The Booted Eagle is not uncommon in Kalat and the Quetta Valley to the Khojak whence it is recorded by St. John, Murray, Meinertzhagen and seen by myself. The records range from March to August so it is apparently a summer visitor. No nesting records.

Duke obtained it at Nal in S. Kalat on May 18 but there are no certain records from Mekran.

Circaëtus gallicus (Gmel.) The Short-toed Eagle.

All there is on record concerning the Short-toed Eagle is St. John's statement that it is not uncommon in Kalat and S. Afghanistan; there is a specimen of his in the British Museum from Kandahar obtained o August 24.

Butastur teesa (Frankl.) The White-eyed Buzzard.

Radcliffe records that the White-eyed Buzzard is fairly common in the Quetta Valley in winter, not seen in summer; but St. John's records one obtained in Quetta in the summer of 1887. I think it must be only a wanderer up to that district.

All through Central Mekran and as far north as Baghwana, N. of Khozdar, it is resident or at the most a local migrant. In coastal Mekran too from Las Belas to Gwader and on to Charbar and Jask in Persian Mekran it is fairly common and is said to occur as far west as Bunder Abbas. Cumming found a nest with three eggs at Jask on April 15 and he informs me that a bird at Charbar attacked a brown dove which had accidentally got under some netting, and he has seen one try to catch a sparrow.

Haliaëtus leucoryphus (Pall.) Pallas' Fish Eagle.

There is very little information as regards Pallas' Fish Eagle; Barnes records an egg which he supposed to be of this species, which was brought to him at Chaman on March 18.

It occurs at Ormarra between December and April according to Cumming, but he did not know whether it bred there.

Haliaëtus albicilla (L.) The White-tailed Eagle.

Only recorded from the Mekran coast where Blanford saw it at Gwader in December and Hume in February. Cumming has seen it at Ormarra occasionally in winter and I saw a magnificent adult bird at the Habb River on November 14.

There are no records in the north. I have no certain record of *Haliastur Indus* in Baluchistan but it is almost certain to occur at least in Las Belas. Murray lists it without comment.

Milvus migrans migrans (L.) The Black Kite.

The Black Kite is a fairly common summer visitor to N. Baluchistan. Barnes says it arrives at Chaman early in the spring and breeds at the end of March; Marshall obtained eggs in the hills near Quetta on April 12, and Meinertzhagen found young in Murdan on May 4. Other breeding places mentioned are Khojak, Kushncb and Ziarat. It would seem that this race replaces *govinda* in the higher hills but the distribution of both wants further working out. It is said to visit the Quetta Valley on passage and I found all had left Ziarat by the third week in September. Five adults examined—Chaman, Quetta, Khawash, and 'S. Afghanistan' appear to be typical ***migrans***. Whether it breeds throughout Kalat and at all in Central Mekran is not known; Hotson obtained one in Panjjur District on April 1, and I saw one at sea off Gwadar on March 13, so that some must pass through W. Mekran on passage.

Milvus migrans govinda, Sykes. The Pariah Kite.

Most observers are agreed that the Indian race is resident and breeds in the Sibi plain, Quetta valley, north to Pishin. Meinertzhagen says a number visit the Quetta valley too from the south during the rains; this would be when young are on the wing. It breeds in April. Some may leave in the winter as Marshall noted they were scarcer at that season. Swinhoe records *migrans* from Kandahar on February 14, 1881, but this specimen, an adult, is in the British Museum and I consider it to be, by its *brown* streaked head, *govinda*, as may be also a young one thence on November 17. The status at Kandahar is not certain as many kites wandered thither during the Afghan War.

At that time our knowledge over the rest of Baluchistan is not at all full. This Kite is common and resident in the Habb Valley and probably too in the Las Belas plain; Cumming says it wanders to Ormarra in winter, Blanford noted that kites were scarce in West Coastal Mekran at the end of January but he unfortunately obtained no specimens. Hotson too unfortunately got none there and made no notes concerning the species which however he met with at Ornach in the Hingol Valley (E. Central Mekran) in September and obtained a specimen. The status, if it occurs at all throughout Mekran, needs working out, though Zarudny lists it as a rare breeding species in Persian Mekran.

Milvus lineatus (Gray.) The Black-eared Kite.

Though unrecorded in Baluchistan this kite must surely occur. Kites were unusually common during the Afghan War of 1879 and three obtained (Juv.) at Kandahar September 13, December 18, and February 23, by their size and new brown feathers on the crown I judge to be *lineatus*. W. 480, 495, 495. In British Museum.

Elanus cæruleus cæruleus (Desf.) The Black-winged Kite.

A straggler in N. Baluchistan of which there are three or four records, adult seen July 7, immature obtained April 7, adult seen August 16, and one obtained by Griffith in 'Afghanistan' was perhaps in what is now Baluchistan. St. John obtained it at Baghwana near Khozdar (S. Kalat) in August; Blanford obtained it at Sonmeani on February 20, and Zugmayer at Las Belas on March 18. No records elsewhere; status uncertain.

Circus macrourus (S. G., Gmel.) The Pallid Harrier.

A fairly common winter visitor to the lower plains and valleys but commoner as a passage migrant; Barnes noted it as very common at Chaman in the wheat fields. It passes through in March to the end of April in the Quetta valley and at Kandahar. St. John records it on spring and autumn passage in Kalat. Murray thought that it bred on the Khojak—'building in May'— but this requires verification.

On the Mekran coast Cumming records it at Ormarra in winter and spring and Blanford obtained it at Gwadar in December. Zugmayer got it in Las Belas in March and April; it is probably not uncommon throughout the Mekran in winter and on passage.

Circus pygargus (L.) Montagu's Harrier.

Montagu's Harrier is probably a passage migrant in small numbers in the north. There is in the Quetta Museum one obtained at Baleli on April 19, 1914 (lab. *macrourus*) and there is one from Quetta in the British Museum; St. John obtained one on the Khojak on September 9, 1881—perhaps the same bird.

Circus cyaneus (L.) The Hen Harrier.

The Hen Harrier is recorded as a fairly common winter visitor from mid-October to April and also on passage though I doubt if sight records can be trusted. I have seen several specimens obtained in the Quetta district in winter, and one from Kandahar.

There is no record in the Mekran but Hotson obtained it at Bampur in Persian Baluchistan in December, so it should occur.

Circus æruginosus (L.) The Marsh Harrier.

The Marsh Harrier is fairly common in suitable spots in N. Baluchistan and Kandahar from October to March.

It occurs here and there in the Mekran in winter.

Buteo ferox ferox (S. G., Gmel). The Long-legged Buzzard.

The status in the north is not clear. Radcliffe says it is resident and breeds in the Ziarat District; Barnes believed that it bred in the Chaman District;

Murray says she found it common at Gulistan in May and obtained on May 7, two young about two weeks out of the nest. On the other hand Meinertzhagen considered it to be absent from March to August though odd birds were seen in May and St. John says that it is not seen in Kalat in the summer. I know of no actual nest having been found. If it breeds at Ziarat all had gone from there in September. It is certainly found throughout the plains and lower valleys during the non-breeding months.

Throughout central and coastal Mekran and in Kalat it is a common winter visitor.

Accipiter badius cenchroides (Severtz.) The Shikra.

Duke and Meinertzhagen both record the Shikra from the Quetta valley in spring and autumn ; it is not a very common bird in the north where however it must breed here and there. Thus Cumming flushed a bird off the nest in Woodcock Spinney near Quetta on June 16, 1922, and St. John obtained it at Kandahar on June 9, where Swinhoe also got one on April 17.

So too it must breed in S. Kalat as Duke secured one at Khozdar on June 12. Throughout Central Mekran it is not uncommon at least in winter ; Hotson obtained four between September 1 and December 12 and Blanford one at Bahu Kalat on the frontier in February where he found it not uncommon. It is not certain whether it breeds in central Mekran. In coastal Mekran it no doubt occurs here and there ; Cumming noted it at Ormarra in March and September.

Birds from central Mekran, S. Kalat, Quetta, and Kandahar (8 sp.) all belong to the race *cenchroides* and not to the Indian form, as also one from Wana in S. Waziristan (N.W.F.P.).

Accipiter nisus nisosimilis (Tickell.) The Asiatic Sparrow Hawk.

This race of sparrow hawk which is so widely distributed through Asia is a common winter visitor to and double passage migrant through N. Baluchistan in October and April.

It is rather a scarce winter visitor to coastal Mekran and there are no records of it, though it must occur, in central Mekran.

Accipiter nisus melanoschistus (Hume.) The Indian Sparrow Hawk.

Radcliffe records that he thinks Sparrow Hawks breed in the juniper forest at Ziarat, where Meinertzhagen also found them in June. However, I think that it is not *nisosimilis* which is said to breed there as the latter suggests, but this Himalayan race. There are birds in the Quetta Museum from Ziarat in July, doubtless breeding birds, and resemble well birds I obtained there in September when it was very common. All these adults are very dark blue above and also very large in size and match quite well birds from the Himalayas. *Nisosimilis* from the plains of India are paler than the typical European race and a series measure W. ♂ 207–216, ♀ 240–258, and this is about the range of measurement of *melanoschistus* which is *darker* than the European bird.

It is interesting to find this Himalayan bird extending to N.E. Baluchistan together with others of the Himalayan fauna. Its chief prey I found to be *Emberiza stewarti*.

Laubmann records *A. n. pallens* from Pishin-Quetta and Loralai but remarks that they are not so grey as Japanese birds. *Pallens* seems a somewhat doubtful race and probably his birds are *nisosimilis*. A female too from Panjgur, central Mekran with a wing of 198 mm. obtained on July 8, is also recorded as *pallens*. If this is sexed correctly it can hardly be a sparrow hawk at all but a Shikra which too is much more likely to be at Panjgur in July.

Accipiter virgatus said to have been obtained by Murray, I do not credit, and two birds from Quetta recorded by St. John as *Accipiter brevipes* are in the British Museum and are in fact *Accipiter nisus nisosimilis*.

Falco peregrinus calidus (Lath.) The Siberian Peregrine Falcon.

Peregrines are recorded as occasional winter visitors from the end of October onwards wherever jheels exist in N. Baluchistan. It would seem to be scarce and possibly some records refer to *babylonicus*. There is one from Quetta in the British Museum.

Cumming has noted it at Ormarra in winter, otherwise there are no records in the Mekran.

Falco peregrinus babylonicus, Scl. The Red-capped Peregrine.

This is the common falcon of N. Baluchistan and is no doubt resident though I have no records of actual nests. Meinertzhagan obtained it at Ziarat in July and saw others in June where I too saw it in September. St. John considered it common in Kalat and at Kandahar. I saw it in the Quetta Valley on August 17 and there is one from there in the Quetta Museum obtained on May 24 and several in the British Museum from Kandahar, Quetta and Kalat. It occurs at Sibi in winter.

At Ziarat I watched for some time some very pretty play-acting by a Shahin which was stooping in turn at each successive magpie which crossed the valley to its roosting haunt.

I saw a shahin at the Habb River on November 14 and Cumming records it from Ormarra on October 21 ; probably a winter visitor throughout the Mekran as it is in Sind.

Meinertzhagen records that he obtained *F. peregrinator* at Kushdil Khan on October 26, but, as he no longer has the specimen, he informs me he is not sure that he is correct in his identification.

Falco cherrug milvipes (Hodg.) The Saker Falcon.

The 'Cherrug' is apparently a scarce winter visitor to N. Baluchistan. There are two specimens from Quetta in the Quetta Museum obtained in January and another from Kushdil Khan on May 17. Murray records it in May and September. No records elsewhere. All examined are of the above race. Blanford (F. B. I., iii, 422) states that St. John obtained one at Quetta ; the latter does not record it nor can I trace the specimen now.

Falco jugger (Gray.) The Laggar Falcon.

The status of this falcon in the north is not clear. Barnes records it as very rare at Chaman but says he saw a pair in April ; St. John regarded it as not uncommon and says he obtained it twice at Quetta ; Marshall too thought it fairly common in the cold weather and located a pair nesting in a cliff in April. Swinhoe records it from Chaman in May and Murray records it in this month at several places between the Bolan and Chaman. Of recent years however no one has met with it.

In S. Kalat it probably is not uncommon. Duke obtained it at Nal on May 2 and Hotson too at Chuttok near Nal on August 26 ; in central Mekran at Jebri in the Mashkai Valley on August 31, and west of Kolwa on April 8 ; so presumably in S. Kalat and central Mekran it is resident as it must be too in Las Belas. Cumming has noted it at Ormarra. Zarudny does not list it for Persian Baluchistan which is apparently beyond its limit of distribution.

Falco subbuteo subbuteo (L.) The Hobby.

I have examined a specimen in the Quetta Museum shot at Pishin-Quetta on October 1. Murray records it from Nushki and Meinertzhagen saw a pair at Ziarat on July 24. Rare ; status unknown.

Cumming records it as a winter visitor to Ormarra ; no other records.

Falco concolor (Temm.) The Sooty Falcon.

The addition of this falcon to the Baluchi avifauna is remarkable and unexpected. Labelled as *F. amurensis*, I found in the Quetta Museum an undoubted specimen of *F. concolor*—an adult male—; it was obtained by W. D. Cumming at Charbar on August 31, 1912 (not October 24, 1912, as labelled). Mr. Cumming tells me that he saw another about the same time in the hills near there ; he further tells me that on May 4, 1901, after a cyclone he took two falcons alive at Ormarra, which he thought at the time were, and of course may have been, *F. amurensis* ; however, they were not preserved.

This is the first record north of Arabia; one recorded from Muscat (*Ibis*, 1886, p. 163) is in such a bad condition that it is hard to say whether it has been correctly identified or not.

The Charbar bird measures W. 278, T. 133. Bill from cere 13. Ts. 33.5 Md. toe 32.5. It has since been sent to the British Museum where Mr. Kinnear kindly compared it with Madagascar specimens, and he finds that it is a very pale bird, but there are insufficient skins in England to define any races.

Falco æsalon insignis (Clark.) The Merlin.

Swinhoe records the Merlin as common in winter at Kandahar; Murray says it is common everywhere north of Quetta and probably breeds in the Khojak, but this requires confirmation. He however says that a bird he examined from Mundi Hissar was a young one with underwing coverts not fully grown. Not recorded of recent years, and no records elsewhere. I have examined two from Kandahar in January and February and two from Pishin-Quetta in December and all are referrable to the above race.

Falco chiquera chiquera (Daudin.) The Red-headed Merlin.

Nicoll Cumming records the Red-headed Merlin from the Sibi plain where it may well occur. Murray says he obtained it at Bibi Nani in the Bolan and also at Kili Abdulla in May but even if this is correct I cannot credit his statement that it is fairly common throughout the country, if by this he means hill Baluchistan. No one has since met with it. No records elsewhere.

Falco tinnunculus tinnunculus (L.) The Kestrel.

The Kestrel is common throughout N. Baluchistan and is resident as a species though very likely some are winter visitors and some summer visitors or passage migrants. It breeds plentifully in cliff faces, holes or ledges in perpendicular river banks at 5 to 10,000 feet and in old Magpie nests. Marshall records 4 fresh eggs on May 14, Betham a clutch of 5 on April 12, but at the lower elevation of Kandahar Swinhoe notes young by the beginning of April.

It breeds as far south at all events as S. Kalat; in central Mekran it is common enough at least in winter and Blanford met with at as late as March 31, and I see no reason why it should not breed there since according to Cumming it is common on the Mekran Coast range round Ormarra and breeds on the headland at the end of March or early in April. To the Las Belas and Sibi plains it is probably only as a winter visitor.

The question is what is the breeding race of Kestrel in Baluchistan? In the North I have only seen birds from Kandahar which at the end of March one may suppose are breeding birds and these are undoubtedly of the typical race ♂♂ W. 249, 250 T. 172; ♀ W. 253, T. 165. All winter birds from Quetta-Pishin and Kandahar in the north and from the Mekran I consider also to belong to the typical race but whether the Mekran breeding bird is also, remains to be proved. Hartert and Zarudny record *F. t. saturatus* as resident in Persian Baluchistan but none from British territory appear to be of this race 6 ♂♂ W. 236–250; T. 163–172; 5 ♀♀ W. 244–268, T. 164–185.

The largest and the smallest birds are precisely alike in colour.

Columba livia neglecta (Hume.) The Rock Pigeon.

'Kapoth' (Bal.). 'Kaftar', (Pers).

Throughout the whole of N. Baluchistan, except perhaps in the forest area, the Rock Dove is common in most places and especially in the valleys and cliffs while in winter it congregates into huge flocks. Besides cliffs, etc., it nests freely in the underground water channels (Karezes) which at intervals have shafts leading into them; eggs and young are recorded in May but probably as elsewhere the breeding season is a prolonged one but not extending to the winter months.

Throughout central and coastal Mekran it is likewise common and resident and one of the characteristic birds of a small resident avifauna; Hotson records eggs on August 21.

I have examined a fair number of these birds, eight from N. Baluchistan and three from the Mekran and I consider all belong to the race *neglectus* the type of which came from Ladak; in Ladak are found Rock Doves with white rumps, *livia* of older authors, alongside birds with blue-grey tinged rumps (*intermedia* of some authors); the same obtains in Kashmir, Gilgit, Punjab, Sind and in Baluchistan. In size their wings vary from 219 in females to 238 in males and Baluchistan birds have the same range of measurement and colour.

Laubmann records *intermedia* from Gwadar; I have seen no *intermedia* from Baluchistan or plains of N. W. India; it is the bird of the Indian Peninsula with dark slate rump and I should much doubt its occurrence, at Gwadar. Laubmann's specimens (four) are small W. 211–214 but perhaps they are not in good feather. North of Gwadar, near Dizak in Persian Mekran, I have seen two typical *neglectus* with wings 231 and 235 and here too may be found whitish or greyish rumped birds ; in the extreme east in the Habb valley *neglectus* also breeds.

Columba palumbus casiotis (Bonap.) The Eastern Wood Pigeon.

The Wood Pigeon is fairly common in the juniper forests at 8,000 ft. at Ziarat and breeds there as it probably does on Harböi in Kalat ; Cumming records it from Zarghun in summer. A good many must leave the forest for the winter as very few were to be seen at Ziarat early in October ; St. John too says in the autumn it is found in the lower hills. Barnes records it at Chaman in winter, leaving for the hills in June. Radcliffe noted it in the Zhob Valley from March to May. It seems to be only a straggler to the Quetta Valley ; Murray recorded it from Kirta, Dozan in the Bolan and Sagee. Swinhoe met with it between the Khojak and Kandahar in April.

South of Kalat the only record is of one obtained at Turbat in Southern Central Mekran on November 27 by Hotson.

Columba eversmanni (Bonap.) The Eastern Stock Dove.

It is strange that this bird is unrecorded in British Baluchistan. One was obtained and another seen at Charbar on September 24, 1912 by W. D. Cumming and it has been obtained in April at Kandahar.

Streptopelia turtur arenicola (Hart.) The Persian Turtle Dove.

A straggler on passage in N. Baluchistan. Swinhoe obtained one at Quetta on May 7. Murray records it at Chaman on April 7 and on the Khojak on May 5.

Streptopelia senegalensis cambayensis (Gm.). The Little Brown Dove.

Chiefly a summer visitor to N. Baluchistan and widely distributed in cultivated parts up to 8,500 ft. ; here and there in the lower valleys some winter while in the Sibi plain it is doubtless resident, as it is at Kandahar breeding there at the end of February. Barnes says it is absent from Chaman from October to March, which probably represent the months of departure and arrival, and breeds in April. Throughout the Nuskhi district it is a characteristic bird. At Sheik Mandah near Quetta eggs are recorded on April 17 and a late brood of young on August 28.

In central and coastal Mekran and in Las Belas it is one of the commonest and one of the few well distributed species and is resident ; it is particularly common in the date groves and cultivation. It extends further west than the Perso-Baluch boundary and is common at Charbar, Bampur, said to occur at Bunder Abbas and has been recorded even in Iraq.

Eleven examined from Baluchistan and Kandahar ; there is no doubt that the breeding bird belongs to the race *cambayensis ;* their wings measure 125–131·5 as in a topo-typical series. Two from Kandahar in March may belong to the larger Turkestan race *ermanni ;* they measured 135 and 139 mm. but a female shot also at Kandahar on the same day is the smallest of any —125 mm.

Streptopelia decaocto decaocto (Fulv.) The Indian Ring Dove.

'Jungli-Kapoth.' (Bal.).

A summer visitor to N. Baluchistan arriving in the second week of March and leaving in October, the Indian Ring-Dove is very common : eggs are recorded from end of April to end of June. It is not found above 6,000 ft. and only occasional birds are seen in winter. In Kandahar and Sibi plains however it is resident ; it is common enough in the Nushki district in April.

A common and characteristic bird of central and coastal Mekran and Las Belas and is resident ; its distribution extends a long way westward of course.

Streptopelia orientalis meena (Sykes.) The Indian Rufous Turtle Dove.

Meinertzhagen informs me that he obtained two on passage at Quetta on October 1 and June 3.

Œnopopelia tranquebarica tranquebarica (Herm.) The Red Turtle Dove.

Murray recorded this Dove from Sibi where it may well occur as a hot weather visitor ; it is quite likely to occur in Las Belas too.

Pterocles orientalis (L). The Imperial Sand Grouse.

The Imperial Sand Grouse is a resident and also a passage migrant in N. Baluchistan. During September and October enormous numbers pass through the Quetta District doubtless bound for the Punjab and N. Sind, etc., the return passage taking place in March and April. At lower elevations however it is common in winter ; Swinhoe records it as plentiful all the year in the plains west of the Khojak and Hotson found it in numbers coming to water at Nushki on December 15, when a bag of 67 was made ; it is common too in the Sibi plain at this season. It is *the* common winter Sandgrouse in the Zhob and Loralai districts from early September to mid-March.

Some breed round Quetta ; there is a half grown chick in the Quetta Museum obtained on September 12, and Capt. Hanna tells me he saw chicks there in July. Numbers breed at Chaman in May (Barnes) and eggs are recorded thence on June 29. Meinertzhagen has seen them in pairs at Kushdilkhan on July 29, where too W. D. Cumming saw numbers coming to drink on June 28. In the Zhob Valley it is recorded in April and May. Under Harböi Hotson met with it on July 2.

South of Kalat it must breed also ; Zugmayer obtained it on July 13, at Panjgur and Hotson found pairs in several places in this district at the end of April. It is the common Sand-Grouse of the Persian Highlands.

Pterocles lichtensteini lichtensteini (Temm.) The Close-barred Sand Grouse.

In North Baluchistan the status of this Sand Grouse is not clear ; D. Radcliffe believes that he saw it once. Tufnell records that two were shot and several seen on the Bhor Plain (locality?) in 1879. Newnham records it from near Quetta. It must I think be rare and Kalat and N. E. Baluchistan mostly too high for it.

Throughout central and coastal Mekran however it is in places common and resident affecting as elsewhere rocky desert and scrub at the foot hills. Hotson met with it at Mand and at many places in the Panjgur and Kolwas Districts in April and July and records it as far north as Zayah in Kharan where it must breed (obtained June 27). Cumming has found it in rocky nullahs near Ormarra and it occurs on the Pabb Hills in Las Belas up to the Sind boundary. It extends to Persian Mekran on the one side and to Sind west of the Indus on the other.

I cannot recognize an Asiatic race of this Sand Grouse ; the markings are subject to great individual variation, some are coarsely barred, others more finely in both Asiatic and the typical bird and in both sexes also there is a yellowish and a greyish type in both ; in both the size is alike ; I have examined all the specimens in the British Museum and Tring Museum and my own collection—a large series in all.

Pterocles coronatus atratus (Hart.) The Coronetted Sand Grouse.

Barnes considered the Coronetted Sand Grouse to be less common than the Imperial in the neighbourhood of Chaman but a few breed there. He found two nests on April 30 and in May ; the nests were just depressions scratched out by the birds in the open plain. It appears nowhere to be common in the north ; it is recorded from the Zhob Valley in January and Lt. Searight met with two flocks there on October 4, 1924. There is a specimen in the Quetta Museum from Said Hamid obtained on December 23 ; Tufnell in 1881 recorded it from 'Vitakri years ago.' St. John on the other hand says this is the only small Sand Grouse in S. Afghanistan and generally distributed in small lots and that between Kandahar and the Helmund in July it was common. I have a recent record of it at Chaman in July and there is an egg in the British Museum taken there on May 27, 1908.

In central and coastal Mekran it is according to Hotson the commonest small Sand Grouse, moving about locally in the cold weather. Apart from winter records he met with it at Teghat W. of Khozdar in the valley of the Dhor on August 26th and saw several flocks at Harbud S. E. of Panjgur on April 27.

Barnes' eggs measured 38 × 26·75 and 41 × 27·3 ; shell fine with moderate gloss, creamy white with blotches and streaks of washed-out yellow-brown and pale sepia. An egg in the Quetta Museum obtained (addled) at Panjgur by Mr. Wilson of the I. E. T. may be of this species also; the ground colour is almost white and it has a few pale lilac grey spots all over; it measures 42 × 29.

Pterocles alchatus caudacutus (Gmel.) The Large Pin-tailed Sand Grouse.

Barnes thought that this Sand Grouse was resident at Chaman though he never found its nest, but in suitable places throughout N. Baluchistan it is a common Spring and Autumn passage migrant in early March and in November; Meinertzhagen gives Said Hamid as the best place in the Quetta District. St. John considered it not so generally distributed as the Imperial and a more strictly desert bird; it must breed on and over the Afghan boundary as he noted it between Kandahar and the Helmund in July. To the Sibi plain it is probably a winter visitor as it is found in enormous flocks round Jacobabad at that time.

In Lower Baluchistan records are lacking save that Laubmann records one from Panjgur, Central Mekran, on July 13, 1911 so it apparently breeds there too.

Pterocles senegalensis erlangeri (Neum.) The Common Sand Grouse.

There is very little information concerning this Sand Grouse in N. Baluchistan Marshall says it passes through the Quetta District in September and October and D. Radcliffe also mentions it as a Spring and Autumn passage migrant; it is doubtless found as a resident in the Sibi plain.

All along the Mekran coast and in Las Belas plain it is common and resident. Hotson obtained it on the Persian boundary at Mand otherwise I have no records of it in central Mekran, Jhalawan or S. Kalat; it would appear to avoid the more hilly country.

Pterocles senegallus (L.) The Spotted Sand Grouse.

'Kuttu' (Bal.)

There are very few records of the Spotted Sand Grouse in the hill country of N. Baluchistan; one in the Quetta Museum was obtained at Said Hamid on November 26. However at the entrance to the Bolan Pass and in the foot hills of the Sibi plain it is common enough and doubtless resident. In S. Kalat Hotson met with it at Surab in August. Throughout Coastal Mekran it is met with here and there and is resident moving about but locally. Hotson came across it in the valley of the Nihing in May; it extends into Persian Baluchistan (Jask, Pahrah) and to Bampur but not to the Persian Highlands.

Ammoperdix griseogularis griseogularis (Brandt.) The See see.

The See see is common and resident in N. Baluchistan in all suitable country; it avoids the open plains of course and is not found as high as the forest area but I have seen it at 7,000 ft. and it may be found at much lower elevations than the Chukar is. It especially delights in broken rocky ground at foot hills and the borders of cultivation in the smaller valleys. It occurs too all the way down the Bolan Pass to an elevation very little above that of the Sibi plain. It nests in mid April and May.

Throughout central and coastal Mekran it is common enough also, especially in the lower hills and stony ravines about the bases of the higher ranges. In the hills near the coast it may be found at quite low elevations. During the heat of the day Hotson found that these birds shelter in the Karez pits or openings to the underground water channels. In the south nests may be found by the middle of March.

I have examined a good series from Baluchistan. They vary very much in coloration but are not distinguishable from the typical race.

Alectoris græca koraikovi (Zar.) The Chukar.

'Kabak.' (Pers. Bal.)

In the North the Chukar is common throughout the hill country up to 11,000 ft. and in some places exceedingly abundant; it is very resident hardly moving down at all in winter and so is not found in the lower valleys and plains. The home of the Chukar may be said to be the hillsides above 7,000 ft. where a few bushes, grasses, and other plants are dotted about on the boulder strewn slopes of the higher ranges; from here they work their way down to some stream in the hill valley to drink about 8 a.m. and also to feed in the adjoining cultivation. But in some seasons they are equally at home in the juniper forest (8-9,000 ft.) ; in 1919—a bad Chukar year—they were practically absent from the Ziarat forests. The breeding season begins in mid-April and 6 to 9 eggs are recorded but nests of 15-20 which are said to occur (Barnes) may be the product of two hens. Chukar may still be found, but not so commonly as of yore, on Gatacre and Kitchener Hills close to Quetta and they certainly breed there (6,000 ft.) The gathering together of coveys to drink at favourite places is made use of in Chukar shooting ; the birds must water every day and so if kept off their drinking places by beaters all the Chukar on the hillside may be found scattered about in coveys on the lower slopes near the stream. This does not sound a very sportsmanlike procedure but if a bag is to be made at all it is the only way ; the area is so vast and climbing and walking so difficult and exhausting that without some concentrating of the birds but few coveys would ever be found. In good years some exceptional bags have been made on the best grounds ; thus near Khawash Col. Ramsay informed me that he and two other guns shot over 700 in two mornings shoot. In 1919, a bad year, I shot with Col. Ramsay and the late Major Finnis on the same ground and our bag was only 54. Heavy spring rains are one cause of bad seasons and the other is a very dry winter and spring. Thus in 1902 the birds kept in packs all the summer and never bred as there was no grass seeds, etc. for the young ; the old birds subsisted by digging up roots and the hillsides were scored by burrows 4 to 6 inches deep in places which they had excavated out for this purpose.

Throughout the hills of Central Makran and in the Coastal Makran ranges as low as 3,000 ft. (in Persian Baluchistan as low as 1,600 ft.) this Partridge is common while in Las Belas it occurs in the Khirthar and its outliers, the Pabb and Khuda ranges.

I have examined the following specimens, Quetta District 6, Kalat 6, Panjgur 1 Khirthar (Sind) 3, Persian Makran 2 (topotypes) and all appear to me to be the same though there is some individual variation, and I assign them all to Zarudny's race *koriakovi*. Wings 148-164 mm. Birds from the Suleiman Range in the extreme N.E. I have not seen.

Francolinus francolinus bogdanowi (Zar.) The Black Partridge.

' Port.' (Bal.)

In the North the Black Partridge is found in cultivation and suitable jungle, in some places, up to 3,000 ft. It is common enough on the Sind frontier and at the other end of the plain in the Sibi District and is found in the Marri and Bugti country below 3,000 ft. In the Loralai District it apparently reaches up to 5,000 ft. and is found at Gumbaz, Mekhtar, Musa Khel, Toi Sar and eastward of this line according to Lt. Searight. I have no records from the Bolan but it occurs as far as Babar Kach in the Harnai Valley ; odd records of birds in the Quetta Valley are doubtless due to escapes. It occurs again in the Kandahar District.

In S. Kalat it occurs as far north at all events as Khozdar (3,000 ft.) and St. John says even to 4,000 ft. In central and coastal Mekran it is common in many of the valleys such as those of the Habb, Dhor, Mashkai, Hingol and Nihing Rivers.

The Sibi plain and Las Belas birds are almost certain to belong to the Sind race *henrici* but I have not examined any. I have examined twelve birds, those from W. Coastal Makran. (Dasht. R.) Central Makran (Mand, Nihing River, Buleda District, Kolwa District), are *bogdanowi ;* 3 birds from Hingol River S. Kalat and Jhalawan are rather intermediate between *henrici* and *bogdanowi*. Many of Zarudny's points of diagnosis of this race do not hold good but I think that *bogdanowi* is distinguishable through its paler coloring and paler neck ring from *henrici*. Wing 10 ♂♂ 153-164, 2 ♀♀ 156-160.

Francolinus pondicerianus mecranensis. (Zar.) The Grey Partridge.

The Grey Partridge is found in suitable spots round the Sibi plain and in the lower end of the Bolan to Kundilani : Col. Ramsay informs me that it occurs too in the lower hills of the Marri and Bugti country. Ball records it from the valleys of the Suleimans and Lt. Searight informs me it is very numerous on the Rakhni plain below Fort Munroe and is found in the Loralai District in the same localities as given for the Black Partridge.

Common in Las Belas it extends throughout coastal and central Mekran in suitable scrub jungle to Persian Baluchistan and on to Lars and Bunder Abbas in E. Persia. It occurs in S. Kalat and Hotson found it at Wad 4,000 ft. in Jhalawan and in the valley of the Mashkai at Pirander 2,000 ft., but it does not as a rule appear to ascend as high as the Black Partridge does.

Ten examined from Jhalawan and Mashkai Valley west to Persian Baluchistan and all belong to the paler greyer form described from the last locality. None seen from the Sibi district or Las Belas which may be *interpositus* or intermediate between the two races as are some from S. W. Sind.

Coturnix coturnix coturnix (L.) The Quail.

'Kurrak' (Bal.)

In the North the Quail is chiefly a passage migrant and in small numbers, a few however must breed as a nest with eggs is recorded by Meinertzhagen taken by a native near Quetta at the end of May; at Kandahar Swinhoe recorded that the Quail arrives at the end of March and St. John says it breeds there in April and May in the cultivation and in similar places elsewhere as perhaps at Fort Sandeman, where birds have been seen in May though it is chiefly a passage migrant there in April and September.

In Coastal Mekran it is a passage migrant in mid-August to the end of September, at times fairly plentiful while a few over winter. W. D. Cumming tells me that on August 20, 1901 a flight attracted by lights entered the offices of the telegraph station at Ormarra and many were also killed by the wire cable round the compound. In Central Mekran it has only been noted on passage.

Coturnix coromandelica (Gm.) The Rain Quail.

The Rain Quail is only recorded from the Habb Valley where Le Messurier saw old and young on September 1st. Probably some occur every good monsoon.

Marshall records in the *Quetta-Pishin Gazette* that another Quail, other than the common, is occasionally seen in the hills but none has been shot. On October 2, 1912 W. D. Cumming saw at Charbar a Quail of a species quite unknown to him.

Rallus aquaticus korejewi (Zar.) The Water Rail.

A straggler in winter to N. Baluchistan; only records:—one near Pishin January, 1899, Quetta two in November, one in December, one March 1.

Porzana parva (Scop.) The Little Crake.

St. John obtained the Little Crake in the autumn at Quetta. Swinhoe found it rather common near Kandahar and obtained specimens in February and March. There is in the British Museum one from the Bolan Pass where Murray records it as common. There is a specimen in the Quetta Museum from Quetta August 31. (lab. *pusilla*).

Porzana pusilla pusilla (Pall.) The Eastern Baillon's Crake.

Baillon's Crake is a passage migrant in N. Baluchistan in August and September, probably not uncommon. Barnes noted it as abundant at Chaman in September; St. John met with it at Quetta in the autumn. Two specimens obtained August 24 in different years are in the Quetta Museum. It has been obtained at Nushki in September and at Chagai on October 7.

Status in Lower Baluchistan unknown; probably a winter visitor as in Sind. One was obtained by Butler in Mekran, and one by Hotson on September 10 at Sib on the Persian side.

Porzana porzana (L.) The Spotted Crake.

Status probably similar to last. There are specimens in Quetta Museum October 1 and November 1. W. D. Cumming obtained it at Ormarra in Mekran on September 20. Zurudny's *Porzana p. maculipennis* described from Seistan appears to be an aberration.

Gallinula chloropus parvifrons (Blyth.) The Waterhen.

St. John obtained one at Kandahar in April; Barnes had several brought to him at Chaman in March; Murray got it there April 31.

In Lower Baluchistan, Blanford obtained it on the Persian side at Sibi March 26, and Hotson saw it at Harbud Central Mekran on April 27.

Mr. Ludlow has a clutch of 6 eggs from Sirunda jheel, Las Belas, taken on June 20, 1915 which certainly seem to be of this species.

Porphyrio poliocephalus poliocephalus (Lath.) The Purple Waterhen.

'Bistuni.' (Pers.)

Porphyrio poliocephalus seistanicus Sar and Harms. The Seistan Purple Waterhen.

It is possible that a few Purple Waterhens may be resident in the Quetta district; Marshall records seeing 7 or 8 in thick reeds in a small river near Quetta in August and thought that they bred there; Barnes records that it is a straggler at Chaman after rain (September 10). St. John says a few occur yearly in the autumn at Quetta. Swinhoe obtained it at Kandahar in March whence Murray also received specimens. In suitable jheels in the Sibi District it doubtless occurs. It is recorded from Nushki in January.

Further south, however, it is commoner. Hotson met with it numerously in August and September in the valley of the Mashkai and northwards to Kalat, as high as 5,190 ft. He met with it too in the valley of the Hingol at Korak (Kolwa) and Rekin (Arawan) on April 18. It is common also in Las Belas.

I have examined 4 Baluchi specimens; two females near Kalat measure W. 268 and 258, and must, if sexed correctly, be *seistanicus* and a Nushki male. W. 269 is probably also of this race.

One from the Hingol River however, is too small W. 242 and must be placed under the typical race as almost certainly too will be found to be the Las Belas and Sibi birds.

Fulica atra (L.) The Coot.

The Coot is a non-breeding visitant to N. Baluchistan, common enough on larger sheets of water (Kushdil Khan, Seranan, etc.) while odd ones occur in the small rivers also. At Kandahar and Chaman it has been noted on passage in February and March. Common in suitable spots in the Sibi district. Though no doubt, the majority are winter visitors quite a number remain throughout the summer; it has been noted on Khushdil by Meinertzhagen and W. D. Cumming in May, June and July, and it has been obtained at Sibi at the end of May. One which Cumming obtained at the end of June was flightless through moult.

In Mekran it doubtless occurs in suitable waters though there are few records; W. D. Cumming obtained it at Ormarra in November and December.

Megalornis grus. The Common Crane.

Cranes are recorded migrating north over the Quetta district. In the Mekran too Blanford saw them performing a similar migration. Hotson noted the first arrivals in S. Kelat on September 24 to 30. Probably here also a passage migrant; but there are so few records anywhere that the status is uncertain.

A. virgo probably also occurs, but there are no positive records.

Tetrax tetrax orientalis (Hart.) The Little Bustard.

Swinhoe obtained a Little Bustard at Kandahar; Murray records one from near there on November 13. Cumming obtained one at Ormarra in Mekran in 1904 and its wings are in the British Museum. Evidently a rare straggler anywhere.

Otis tarda has been obtained in S. Afghanistan at Bala on the Murghab R. but not so far in Baluchistan.

Chlamydotis undulata macqueeni (Gray.) The Houbara.

'Charz' and 'Charras.' (Bal). 'Thukder,' 'Thukderri.' (Pers.)

The Houbara occurs in N. Baluchistan mostly as a passage migrant, but here and there in the valleys and plains some may be met with in winter.

It has been found at the end of March and in April in large numbers especially on the plains between Pishin and the Kwaja Amran ; Meinertzhagen records that 60 were shot there in one day by 4 guns. It passes through again in the autumn, while to the Sibi Plain it is a winter visitor in suitable places, as also noted by Masson over eighty years ago.

Throughout the Mekran it is found in winter in fair numbers wherever there are sandy plains and scrub jungle, and it even frequents the sandhills of the coast, while cultivation such as rape, etc., or date groves are an attraction ; so too is water. Cumming tells me he has seen 12 or 15 of these birds at a time in the vicinity of shallow rain-pools in the sandhills waiting to come to drink (5.30 p.m.). When the water fails they will come in to drink at spills from wells But in the Mekran some, however, nest. Hotson obtained one at Nikin Daf, 53 miles out on the Panjgur-Kalat road on June 8, and had a half grown young one brought in alive on June 11 at Panjgur. Cumming too has met with a family party ; he tells me that once at Ormarra six were driven towards him, two adults and four small ones ; unsuspicious of his presence, the male ran on and went behind a bush and then faced round to the others, working his neck plumes to cover and uncover the white in front, waiting until the female ran up which then went through a similar performance whilst the male took charge. Cumming further informs me that his predecessor at Ormarra had Houbara chicks brought in.

Sypheotides indica (Gmel.) =*aurita* auct. The Florican.

The Florican occurs at least in the eastern part of Coastal Mekran in some years. Le Messurier records that on October 3, 15 were shot on the Baluchi side of the Habb R., and that one at least was only ' nearly fledged ' and all were in brown dress. Cumming once came across a couple at Ormarra and obtained one. Hotson too obtained one in the river bed of the Hingol R. at Gili on September 10. Probably it is a rain visitor as in Lower Sind.

Œdicnemus œdicnemus astutus (Hart.) The Stone Curlew.

' Kurwanak '.

In N. Baluchistan the Stone Curlew is probably not so rare as records indicate and its status is doubtful. Marshall obtained it in March, Meinertzhagen got a pair in the Popalzai Forest on April 9 ; W. D. Cumming tells me he has seen recent footprints of this bird at Sheik Mandah near Quetta on July 16. Lt. Searight informs me that he saw these at Loralai on March 13, 1925, and that one at Kuria Wasta on May 23, 1924, certainly had young. I have examined two in the Quetta Museum obtained at Saranan on October 12, and at Mithri near Sibi October 25, and both these belong to the race *astutus*, as does one in the British Museum from Gandaka (Sibi plain) ; in this last locality it is probably not uncommon and resident.

In Central Mekran it must be fairly common as it was well known to Mr. Wilson of the Indo-Persian Telegraphs at Panjgur, and the natives there had the above name for it. Throughout Coastal Mekran it is fairly common ; Cumming met with it fairly often at Ormarra and Charbar, and found a nest at the former place on April 16. The only Mekran bird I have seen comes from Gili in the Hingol valley ; this is a fresh moulted bird and is far more rufus than any *astutus* I have ever seen, and I cannot pick it out from a series of *saharæ !* It is a male W. 236 B. 32. It may be noted I have recorded both these races from Iraq ; these Asiatic Stone Curlews want further study with more material.

Esacus recurvirostris (Cuv.) The Great Stone Plover.

The Great Stone Plover extends its range at least as far as Ormarra along the Mekran coast where W. D. Cumming has met with it. It breeds at Sonmeani whence I have seen eggs in Mr. Ludlow's collection taken in June. Swinhoe found a nest in the Habb R. near Minad Khan on May 24. It doubtless breeds in other suitable places.

Dromas ardeola Paykuki. The Crab Plover.

Bishop obtained three on the Mekran coast in January and Cumming shot one on the beach at Ormarra on September 4. Probably a rather uncommon winter visitor.

Cursorius coromandelicus (Gmel.) The Indian Courser.

The only record within our area relates to birds shot by Cumming at Roumii in the Pabb Hills, Las Belas. It should occur throughout Las Belas in suitable places as it is common in the plains on the Sind side of the Habb Valley.

Cursorius cursor cursor (Lath) = *gallicus*. The Cream-coloured Courser.

Brahui. 'Askalo'.

This courser would seem to be uncommon, judging by the records, in N. Beluchistan ; Barnes says it was not often met with at Chaman ; Marshall obtained it in September ; W. D. Cumming has seen it near Quetta in September and October ; St. John met with it at Pishin in August. Meinertzhagen came across a few pairs near Quetta in April and one in the Quetta Museum was obtained there in March. At Sibi it occurs and might well breed in the plain and the same applies to the Nushki plain where Hotson found it at Munchi Chah. T.P. on April 18.

In S. Kalat and Central Mekran it is evidently not uncommon as Hotson came across it there a good many times in August and September. Along the Mekran coast it occurs in suitable places and Cumming notes it as a winter visitor August to April at Ormarra but at Jask on the Persian side he had eggs brought him on March 1 which he considered were of this species.

I cannot differentiate an Indian race of this courser.

Glareola pratincola pratincola (L.) The Pratincole.

Swinhoe obtained one at Bibi Nani in the Bolan Pass on May 18, 1881 and St. John got another at Kandahar, April 23, 1879. Otherwise no other records in N. Baluchistan, though Cumming tells me he thought he saw it at Khusdilkhan June 27, 1923. It probably breeds at the Sirunda jheel in Las Belas, as a shikari, whom Mr. Ludlow sent there, and who knew the birds well in the Sind colonies, reported that he saw them there in May.

Hydrophasianus chirurgus (Scop.) The Pheasant-tailed Jacana.

One was seen near Quetta by Meinertzhagen, doubtless a straggler, on July 11. It should, however, occur in jheels near Sibi, as it is common in N. Sind.

Arenaria interpres interpres (L.) The Turnstone.

Not uncommon on the coast of the Mekran, associating with other surf-feeding waders. Latest date May 25. No records inland.

Lobivanellus indicus aigneri (Laub.) The Red-wattled Lapwing.

Falco ix, p. 30, 1913—Sonmeani in Las Belas.

The Red-wattled Lapwing is not very common in N. Baluchistan, but a few pairs are probably resident in the Quetta district. Both Meinertzhagen and myself have met with pairs on the Lora R. in August, and Cumming has seen them there in June and also at Khusdilkhan. Radcliffe saw a few at Ziarat in June and July. Barnes considered it uncommon at Chaman owing to lack of water but found a nest on May 10. Ball records it from the higher parts of the Suleimans 3-5,000 ft. in July where it must also breed. It is common and resident on the Anumbar River from Wahar to Gumbaz (Loralai District). There are scattered records from Quetta in winter. According to Swinhoe it is common at Kandahar and in the Bolan Pass, while at Sibi it is of course, plentiful, as it is in parts of Kalat.

As regards Central Mekran, information is lacking, but it is sure to occur. From the Habb R. through Las Belas and along the Mekran coast it is resident in suitable places and thence extends to Persian Baluchistan, Persia (Henjam, Bunder Abbas, Shiraz,) Muscat and to Iraq. I have already (*Ibis*, 1923, pp. 665–6) dealt fully with this race. Briefly it has less green and purple sheens than the typical race and averages very slightly larger.

Murray records the Yellow-wattled Lapwing *Sarciophorus malabaricus* from Soriab and Quetta as not uncommon in the last week of March ; as by this date the first have only just reached Lower Sind, and as I have on records of this species from Upper Sind at all, it is extremely unlikely to be found at 5,000 ft. in the Quetta valley. It may, however, well occur in Las Belas.

Vanellus vanellus (L.) The Lapwing.

The Lapwing occurs in the Quetta Valley, Kandahar and in suitable spots in Kalat as a winter visitor, sometimes in large flocks; earliest record August 2. In Mekran, Hotson met with it at Turbat in the Nihing Valley on November 28, otherwise there are no records though it probably occurs in suitable places.

Chettusia gregaria (Pall.) The Sociable Lapwing.

Barnes noted the Sociable Lapwing as very uncommon at Chaman; Murray records it thence in April.

Chettusia leucura (Licht.) The White-tailed Lapwing.

The White-tailed Lapwing occurs in the Quetta Valley chiefly as a spring and autumn passage migrant, but it has also been obtained in December. To Kandahar, however, it is a common winter visitor, as it is in Kalat and probably to the Sibi plain in suitable spots; earliest record September 11. It should occur in winter in the watery parts of the Mekran and Las Belas, but the only records come from the Persian Mekran in March and November.

Squatarola squatarola squatarola (L.) The Grey Plover.

A not uncommon winter visitor to the coast of the Mekran. Mostly singly or in pairs as a rule.

Pluvialis apricarius (L.) The Golden Plover.

One was obtained by Blanford at Gwadar in December. Murray records that he saw *P. d. fulvus* near Sibi. It should occur, but I have no positive record; it has been obtained at Kalati-Ghilzai in S. Afghanistan and at Karachi. The European bird is but a vagrant.

Charadrius leschenaulti (Less.) Geoffroy's Sand Plover.
Charadrius mongolus atrifrons (Wagler.) The Mongolian Sand Plover.

Both these Sand-Plovers were obtained according to Mr. Finn on the 1896 Baluchi-Afghan Boundary Expedition; no locality given. The larger species has been obtained at Quetta in March, a flock of six were noted, doubtless on passage. Both species are common on the coast of the Mekran in winter.

Charadrius dubius curonicus (Gmel.) The Little Ringed Plover.
Charadrius dubius jerdoni (Legge). The Indian Little Ringed Plover.

The Little Ringed Plover is fairly common in suitable spots throughout N. Baluchistan; to the Quetta District it is a summer visitor arriving at the end of February or early March and leaves in August; it breeds freely round such waters as Khushdil Khan and on the gravelly stretches of the Lora R. Meinertzhagen thus records them and noted eggs in the first half of June. At lower altitudes, St. John indicates that it is a winter visitor, as he says that this and the Kentish Plover are common in cold weather ' beyond the passes '. Swinhoe too found it at that season at Kandahar whence it disappears in April.

Throughout Central and Coastal Makran and S. Kalat it certainly occurs not uncommonly, but all records and specimens relate to dates between August 25 and April 15 so it is uncertain whether it breeds or not. In Las Belas I believe it breeds, however. I shot a pair in the Habb R. on June 16, which had the appearance of having bred.

As regards the races which occur; three March birds from the Quetta District which I have examined are certainly *curonicus*, as are two April birds in Meinertzhagen's collection, and he tells me that he was in error in recording them as *jerdoni*; spring and autumn birds from S. Baluchistan also are all *curonicus*. The only *jerdoni* I have seen from Baluchistan are the above recorded birds from the Habb Valley.

Charadrius alexandrinus alexandrinus (L.) The Kentish Plover.

The status of the Kentish Plover in N. Baluchistan is much the same as that of the Little Ringed Plover; it arrives according to Meinertzhagen in the Quetta District early in April and leaves in September. It nests freely at Kushdil Khan on the dried muddy margins and islands of the Jheel; eggs were found by Meinertzhagen on May 18 and June 2, on the latter date a clutch of four. Cumming found several nests with 1 to 3 eggs on June 26. To Kandahar it is a winter visitor.

In the rest of Baluchistan it is recorded from the Mekran Coast where it appears to be a common resident though the only note of an actual nest is from Jask on the Persian side (young 10 days old on May 24). In Las Belas I found a pair or two on June 16 in the Habb Valley which seemed to have finished breeding. It must occur here and there in Central Mekran but the only record is from Isfandak on the border where Blanford obtained one on March 8.

Hœmatopus ostralegus longipes (But.) The Oyster-catcher.

The only record in the north is Meinertzhagen's who has seen this bird at Kushdil on April 29 and May 17.

A winter visitor to the whole of the Mekran Coast in variable numbers.

Himantopus himantopus himantopus (L.) The Stilt.

To the very few suitable localities the Stilt is a summer visitor in variable numbers in the north. It breeds at Kushdil Khan where Meinertzhagen found nests in 1913 and 1914 and Cumming in 1923. It arrives early in March and leaves in August ; at Kandahar it is common too in March but there is no information as to whether it breeds there Full cultches are recorded on June 10 and June 17 in different years. Many eggs get taken by natives and at times many are destroyed by sudden rising of the waters.

I have no record of the Stilt breeding on the Mekran Coast except in Las Belas ; here at the great Sirunda Jheel at Sonmeani a good many nest on the dried margins. Ludlow has eggs taken there on May 20 and I have young in down thence taken July 13 ; here it is practically resident but in the rest of the Mekran it is a fairly common winter visitor.

Recurvirostra avocetta avocetta (L.) The Avocet.

Meinertzhagen records that a few pairs arrive at Khushdil early in March and that in 1913 one pair bred ; after disturbing the nest the eggs were transported by the birds across the lake (600 yards) to the other side ! None bred in 1914 and in 1923 Cumming saw a fairly large flock on June 26 which was very wild so presumably were not breeding. No doubt variations in local conditions determine whether any breed or not. Murray records it at Sibi in March otherwise there are no other records in the north.

To the Mekran Coast it is said to be a winter visitor in small numbers.

Limosa limosa limosa (L.) The Black-tailed Godwit.

It is peculiar there are so few records of this bird in N. Baluchistan ; Marshall obtained one at Babar Kach in March. Murray records it in the Bolan Pass in March and April ; at Kandahar Swinhoe found it numerous on passage in March. No one seems to have met with it in recent years but surely it must occur ?

It is fairly common in Central and Coastal Mekran in suitable spots in September and October (earliest September 4) and probably it overwinters but records are lacking.

Limosa lapponica lapponica (L.) The Bar-tailed Godwit.

There is specimen from Baluchistan in the British Museum ; doubtless from the Mekran Coast where it should be numerous in winter.

Numenius arquata lineatus Cuv. The Curlew.

The Curlew does not seem to halt much on passage in N. Baluchistan as Meinertzhagen considered it uncommon, he met with it only on April 9, August 12 and September 30. Capt. Hanna informs me he heard many passing over Chaman on the night of July 31, 1919. There is one in the Quetta Museum from Saranan on April 9.

There are no records from the rest of Baluchistan save from the Mekran coast where it is fairly common in the mangrove swamps in winter.

Numenius phæopus phæopus (L.) The Whimbrel.

I can find no record of the Whimbrel in the north where it surely must sometimes occur on passage. Some winter on the Mekran Coast but it probably is commoner on passage there. W. D. Cumming informed me that both Whimbrel and Curlew on the Mekran sometimes come inland and feed in the sandhills. Hotson obtained one at Sibi on the Persian Mekran on September 9.

Phalaropus lobatus (L.) The Red-necked Phalarope.

The Red-necked Phalarope must occur annually on autumn passage in N. Baluchistan. Barnes met with it in September and St. John on October 19 at Chaman ; there is a specimen from Kushdil in the Quetta Museum obtained on September 10 and Cumming picked up a dead bird near Quetta on September 23 ; at Sibi I have seen it on October 8. On spring passage it is recorded on March 6 and 28, April 30 and on May 5.

As in Sind so in S. Kalat, Jhalawan, and Central Mekran it is not uncommon on autumn passage, Hotson meeting with several small lots at various places between September 2 and October 4. Having reached their winter quarters few linger on land on the Mekran coast but Cumming once saw a pair in a rain water pool at Ormarra. At sea off the Mekran coast it is an excessively abundant winter visitor though its distribution is patchy ; one may steam for hours and never see one and then come across flock after flock each containing 100 or more individuals and they are always very wild allowing no boat to come within 200 yards as a rule. Sometimes they come as near the land as Ormarra May but they are more often met with 4 to 10 miles and even to 30 miles from the coastline, as soon however as very deep water (over 200 fathoms) is reached not one is to be seen. Butler records them from this coast as late as May 20 but as in Sind few or none appear to halt on spring passage inland in Mekran. Numerous off the coast by mid-November Hume's notes under *Phalaropus fulicarius* (S.F. vol. i) and Blanford's (Eastern Persia, vol. ii, p. 284) all refer in reality to the above species.

Limicola falcinella falcinella (Pont.) The Broad-billed Sandpiper.

Occurs throughout the Mekran Coast in winter where it is probably quite common. Hotson obtained it on passage on the Rhotak River on August 3 but there are no other records away from the coast, but it is likely to occur on passage.

Terekia cinerea (Gulden.) The Terek Sandpiper.

Recorded from Sonmeani and Ormarra on the Mekran in winter ; probably common along the whole coast line. No records elsewhere.

Erolia minuta minuta (Leisl.) The Little Stint.

'Tanki', Baluch for small waders.

A double passage migrant in N. Baluchistan, passing in numbers in April (latest date May 28) and again in September and October ; a few are said to over-winter. In Central Mekran the only records refer to September and April so it is probably a passage migrant ; on the Mekran Coast it winters in numbers having arrived there by mid-September.

Erolia temminckii (Leisl.) Temminck's Stint.

There are curiously few records of this very common Indian bird but this is probably due to its being overlooked. Hotson obtained it on the Nihing River in winter and Blanford and myself met with it in the Habb Valley in October and November.

Erolia alpina alpina (L.) The Dunlin.

In N. Baluchistan it has only been noted at Khushdil Khan and Quetta on passage on November 30 and in third week of May ; it may be commoner on passage than records indicate. Very common on the Mekran Coasts in winter but unrecorded elsewhere.

Erolia ferruginea (Brün.) The Curlew Sandpiper.

Meinertzhagen found it common at Khushdil Khan on May 16 to 20 ; Murray records it from Quetta on March 22. It occurs in winter on the Mekran Coast.

Erolia canutus canutus (L.) The Knot.

Meinertzhagen obtained a solitary bird at Khushdil on March 26 the only record for Baluchistan and India.

Erolia tenuirostris (Horsf.) The Great Knot.

The Great Knot was seen by Hume near Gwadar in winter ; this is the only record but it probably occurs in other places on the Mekran Coast although it is unknown anywhere west of Gwadar.

Calidris alba (Pall.) The Sanderling.

Only recorded from the actual coast line of Mekran where it is abundant in winter. The Sanderling must be capable of immense flights, it has never been found on passage on land in India.

Machetes pugnax (L.) The Ruff.

A spring and autumn passage migrant in N. Baluchistan, not uncommon in suitable spots. Marshall obtained one in February but most pass through the Quetta Valley in March and the same applies to Kandahar. Odd birds are recorded from Khushdil Khan in December ; it has been noted on passage again in October. Both in Central and Coastal Mekran it has been obtained in September and in winter.

Totanus totanus eurhinus (Oberh.) The Redshank.

In N. Baluchistan the common Redshank does not appear to be very common. Meinertzhagen only noted it twice—small flocks at Khushdil on October 26 and May 19. St. John considered it common in winter till mid-April but this very likely referred to the Kandahar plain whence Swinhoe recorded it as common in winter. W D. Cumming saw non-breeding birds at Khushdil on June 26.

To Coastal Mekran it is a not uncommon winter visitor, earliest noted on August 20, and it occurs in Central Mekran also in winter. Meinertzhagen must have made a slip in recording as *T. erythropus* a bird he shot at Khushdil on October 26 ; this bird is in the Quetta Museum and is undoubtedly a common Redshank ; specimens of *erythropus* in the Quetta Museum recorded by D. Radcliffe were in fact obtained in Sind. However this bird should occur in Baluchistan and Murray lists it without comment.

Totanus stagnatilis (Bech.) The Marsh Sandpiper.

There is one in the Quetta Museum obtained on August 15, at Saranan. W. D. Cumming informed me that it occurs at Ormarra in winter. These are the only records and like the Greenshank it is probably overlooked or badly recorded.

Totanus nebularius (Gunn.) The Greenshank.

St. John records the Greenshank as not uncommon in Kalat and S. Afghanistan in winter and Swinhoe considered it a winter visitor to Kandahar. In the Quetta District it appears to be uncommon as there is only one record—a bird obtained at Bostan on November 9. In Coastal Mekran Cumming noted it at Ormarra in winter and I have seen it in the Habb Valley ; it probably occurs here and there throughout the Mekran.

Tringa hypoleucus (L.) The Common Sandpiper.

During spring and autumn passage the common Sandpiper is common on the streams and waters of N. Baluchistan ; the birds pass through from early April to the end of May returning again in August. Delmé Radcliffe thought it possible that odd pairs breed at Khushdil but no further evidence has been obtained of this. Meinertzhagen however has brought forward strong circumstantial evidence that a pair bred on the Arak stream at 9,000 ft. in 1914. It would not be surprising to find that here and there at that elevation a pair or two do nest in the forest area.

To the Sibi plain and the rest of Baluchistan it is a winter visitor in fair numbers.

Tringa ochropus (L.) The Green Sandpiper.

The Green Sandpiper is probably the most generally distributed and least rare of all the waders in N. Baluchistan since it can adapt itself to the merest puddle or trickle ; moreover besides being a bird of both passages it is also a winter visitor. Odd birds also may be seen throughout the summer months as obtains in many parts of N.W. India, though none of course breeds. It has been recorded at 8,000 ft. but is equally at home in winter in the Sibi plain.

Throughout Kalat, Central and Coastal Mekran it is a common winter visitor wherever there is any water and here too some over-summer.

Tringa glareola (L.) The Wood Sandpiper.

In N. Baluchistan the Wood Sandpiper is a common passage migrant in April and May, rather less common on autumn passage in August ; odd ones are recorded in winter. In Kalat St. John remarked that it is common in summer but he probably meant in May and August.

In Central Mekran it must be common enough at least on passage but records are very few and relate to March, April and September.

Scolopax rusticola rusticola (L.) The Woodcock.

A few occur every year in N. Baluchistan from 5–8,000 ft. Newnham records 20–30 were shot in the winter of 1888 and that the main arrivals came early in December, earliest November 11. Swinhoe states that 5 were obtained in one day. Meinertzhagen gives October and February as the extreme dates. No records elsewhere.

Capella solitaria (Hodg.) The Solitary Snipe.

An annual visitor to N. Baluchistan in October, earliest September 29, but more appear to come in some years more than others. In Quetta it has been found in gardens in the cantonment, suitable places being few, while at Ziarat one for several days haunted a piece of swampy grass a few feet square caused by a leak in a water pipe. Some must over winter as Duke obtained one at Kalat in December and I have heard of one shot in January somewhere between Quetta and Fort Sandeman while another was obtained near Loralai on March 13, 1925.

Capella gallinago gallinago (L.) The Common Snipe.

A common passage migrant in N. Baluchistan while a few over-winter in suitable places. Meinertzhagen gives mid-August as the earliest date, most arriving in September and passing through again in March and a few till the end of April : 83 couple is the largest bag for one day. To the Sibi plain, Central and Coastal Mekran it is a winter visitor arriving at the end of August (24 and 28 in two years), corresponding pretty well with the first arrivals in Lower Sind. A creamy white specimen obtained at Sibi on March 22 is in the Quetta Museum. I have no record of the Pin-tailed Snipe in Baluchistan (*C. stenura*) but odd ones are almost certain to occur.

Limnocryptes minima (Brünn.) The Jack Snipe.

Occurs throughout Baluchistan in suitable places arriving in mid-October (Quetta and Mekran ; as also in Sind) ; it is particularly common on spring passage in the north according to Meinertzhagen who has seen a 100 in a day. At Kandahar Swinhoe noted it as a weather migrant at the end of December. I know of no certain record of the Painted Snipe though Murray lists it without comment.

Larus fuscus taimyrensis (But.) The Lesser Black-backed Gull.

Larus argentatus cachinnans (Pall.) The Yellow-legged Herring Gull.

Both these Gulls are very common along the Mekran Coast in winter from early November at all events up to March 24 and probably later. They act as scavengers at all the coastal villages.

Meinertzhagen records a flock of *cachinnans* at Khushdil Khan on April 17 otherwise there is no record in N. Baluchistan for either species but they doubtless do halt on passage on suitable waters.

Larus ichthyaetus, (Pall.) The Great Black-headed Gull.

One shot at Saranan on March 29 is the sole record of this bird in the North. It is fairly common along the Mekran coast in winter ; Hume obtained one on February 17, which had already attained breeding dress.

Larus brunneicephalus Jerd. The Brown-headed Gull.

Marshall records a large flock at Khushdil in March : in the Makran W. D. Cumming has noted it as a winter visitor as far west as Charbar, so it probably occurs here and there along the whole coast.

Larus ridibundus ridibundus (L.) The Black-headed Gull.

A commom winter visitor throughout Baluchistan wherever suitable spot exist. Meinertzhagen says it arrives in the Quetta Valley by mid-October, most leave in April but some remain till the end of May. He says that he has never seen any near Quetta in breeding dress, which is curious since many assume the brown head before leaving Sind.

It is of course especially common throughout the Makran Coast where it arrives by mid-October.

Larus genei (Breme.) The Slender-billed Gull.

'Kothar' Bal.

The Slender-billed Gull is one of the commonest gulls on the Makran Coast and it is a constant resident though very likely their numbers are augmented in winter. Large flocks may be seen fishing a mile or so out at sea on surface swimming fry. Considerable numbers breed at least in some years on the large island in the Sirunda jheel at Sonmeani, Las Belas. Mr. Ludlow has eggs taken there on May 15 but most are not laid till the first week in June. I have both eggs and young in down obtained there on July 16. The nests are quite considerable structures and Caspian and Gull-billed Terns breed in the colony with them. In some years when the jheel is very full few or perhaps none breed there. It doubtless breeds in several other places in Makran. On May 28, 1878, Mr. Nash of the I. E. T. found a small colony in a swamp at the head of a creek about 8 miles N. N. W. of Ormarra called Moorputti. The nests contained 1 to 3 fresh eggs on that date. The nests were solid pads of seaweed about 8 inches in diameter.

There are no records elsewhere in Baluchistan of this bird.

Larus hemprichii (Brüch.) Hemprich's Gull.

This is probably the commonest Gull on the Makran Coast and is resident. It is a tame confiding bird and may often be seen round boats scavenging fish offal, but unlike the larger gulls does not frequent the villages for this purpose. Early in June these gulls begin to draw in along the Sind coast to the breeding grounds and they congregate in thousands to breed on the island of Astolah, 24 miles S. W. of Pasni. Butler who landed there on May 29, found the plateau of the island already covered from end to end with gulls which were absurdly tame but breeding had not commenced ; scrapes in the sand were plentiful but these may have been for dusting purposes (?) He subsequently sent on August 6 a boat to the island and the natives obtained many fresh eggs for him. The nests were said to be large affairs composed of twigs built in bushes and well concealed ! This is a good example of the inability of the native to describe accurately anything he has seen ; as a matter of fact the nests are a slight depression with a few bents of grass and *salsola* scrub situated at the *side* of and *sheltered* by a tuft of salsola, according to Sir Percy Cox who visited the island on July 17, 1907. The maximum number of eggs appears to be 3,

Chlidonias leucopareia indica (Stev.) The Whiskered Tern.

Meinertzhagen records that several were seen on Khushdil Khan in May 1914 there is one in the British Museum from Quetta May 22. Evidently a passage migrant, as it also is in Central Makran ; Hotson found it on the Rohtak R. near the Persian boundary on September 24, and in the Hingol valley on the 19th. W. D. Cumming observed it at Charbar on August 6.

Hydroprogne caspia caspia (Pall.) The Caspian Tern.

'Kothar' (in Makran.)

The Caspian Tern visits such waters as Khushdil Khan and Saranan on passage. Meinertzhagen has noted them from April 30 to May 17, and a pair till June 20. No evidence of breeding.

On the Makran coast it is common and resident. It breeds with the Gull-billed Terns and Slender-billed gulls on a large island in Sirundha jheel in Las Belas ; laying had just begun on May 15, many eggs were obtained on June 14, and by July 16, most were hatched and some young were nearly ready to fly. A great many eggs I believe are addled by the heat, and the mortality in young too appears to be great. The legs and feet of newly hatched chicks are yellowish-flesh colored.

Geochelidon nilotica nilotica (Gm.) The Gull billed Tern.

' Kothar ' (in Makran.)

No record in N. Baluchistan.

Common and resident on the Makran Coast ; a very large colony breeds in the Sirunda jheel (see above). Mr. Ludlow had many eggs brought him thence on June 16, and I had a few eggs and young up to half grown birds on July 13. Both adults and young had fed on locusts.

Sterna sandvicensis sandvicensis (Lath.) The Sandwich Tern.

The Sandwich Tern is a winter visitor to the Makran Coast in fair numbers. Barnes was informed that it bred there. However this suggestion is not as yet confirmed, nor is it ever likely to be. Unrecorded elsewhere.

Sterna bengalensis bengalensis Less. The Lesser Crested Tern.

The Lesser Crested Tern is common all along the Makran Coast in winter and at all events up to the end of May. Birds shot at the latter date are in full breeding dress. It is however not known to breed in the Makran Coast as yet.

Sterna bergii velox Cretz. The Greater Crested Tern.

The Greater Crested Tern is common and resident on the Makran Coast breeding in large numbers on the island of Astolah off Pasni. Butler who landed there on May 29, 1877 found that this Tern had just commenced to lay. The colony consisted of four large groups nesting together on the bare ground on the most exposed part of the island ; each nest was about one foot apart from the next and he actually found 47 eggs in a space of 8 feet square. As many as 7,000 fresh eggs have been gathered there by natives early in June.

As is well known the eggs of this tern vary so much that hardly two are alike. As in other Tern colonies elsewhere the eggs are liable to be pillaged by Gulls—in this case by Hemprich's Gulls.

From an examination of a large series of this Tern from the Makran Coast, I am of opinion that *S. bergii bakeri* described thence is not a good race and is indistinguishable from *velox*.

Sterna melanogaster Temm. The Black-bellied Tern.

Barnes records that this Tern is not uncommon in the Bolan Pass and he obtained a straggler at Chaman on June 3. St. John obtained another at Quetta in the autumn 1881. Murray lists the Indian River Tern (*S. seena*) but I have no definite record.

Sterna repressa Hart. (= *albigena* auct). The White-cheeked Tern.

Butler met with the White-cheeked Tern in flocks commonly along the Makran Coast in the latter half of May and he remarks that it is one of the commonest terns at that time. Zarudny records it at Charbar on March 16. I think that it is probable that this tern is only a passage migrant on the Makran Coast, to and from its breeding grounds in the Persian Gulf, though there seems to be no reason why it should not breed there.

Sterna hirundo hirundo (L.) The Common Tern.

Meinertzhagen has recorded this tern as plentiful in May and early June on Khushdil Khan.

It must be a passage migrant in Lower Baluchistan but the only record refers to a bird obtained by Hotson at Sib on the Persian side on September 10. Like the Sind birds the Baluchi ones appear to belong to the typical race.

Sterna albifrons. The Little Tern.

Little Terns are only recorded from the Mekran Coast ; Butler mentions seeing this species at Jask in May. W. D. Cumming informed me that *saundersi* may be found throughout the year at Ormarra and he has noted it at Charbar in November but as no specimens were obtained it is not certain. I saw two or three on the Habb River on June 16 but failed to get a specimen. A little tern is very common on the Sirunda jheel in Las Bela nesting in a different part to that occupied by the Caspian Terns, etc.; Mr. Ludlow had eggs brought him thence on May 28, 1915 which Mr. Stuart Baker identified as *saundersi* and on June 16, 1916 he received further eggs and a parent bird, the latter was identified by Mr. Baker as *albifrons* so that it still seems quite doubtful which race breeds on the Mekran and there are no specimens in the British Museum. One from Muscat belongs to the typical race. Major Cheesman obtained *saundersi* from Bahrein Island in April, from Handramaut Coast on May 8 in which month I have seen birds from Port Sudan.

Sterna anætheta fuligula (Licht.) The Red Sea Sooty Tern.

Butler noted this Tern as common on the Coast at Gwadar in the last half of May; Mr. W. D. Cumming has seen it in small flights at intervals during the winter and probably it is only common on passage to its breeding haunts in the Persian Gulf. It frequently roosts on ships passing up to the Gulf.

Anous stolidus pileatus (Scop.) The Phillipine Noddy Tern.

Butler noted a few between Pasni and Jask two or three miles from land at the end of May. W. D. Cumming caught five alive at Ormarra after a cyclone on May 4, 1901; they had taken shelter in some tamarisks.

Evidently a wanderer to the Mekran Coast and its status is not known; it does not breed so far as is known in the Persian Gulf. One of Butler's specimens in the British Museum is of this race.

Murray in his vague way said *Rhynchops albicollis* occurred on the coast; I know of no record; it may however be found as Zarudny records it from Rud-i-Sarbas in Persian Baluchistan.

Stercorarius parasiticus (L.) Richardson's Skua.

Richardson's Skua is not very uncommon along the Mekran Coast where Hume met with it at sea off Ormarra, Pasni, Gwader, etc., from the middle to end of February. Butler too saw about a dozen between Pasni and Gwader as late as May 13-17. Hume obtained one and made it the type of his *S. asiaticus*; it is in the British Museum where I have examined it; it is a young light-barred bird moulting body, wings and tail (February 16) to the light adult phase. I did not see this bird for certain along this coast in March and November. Curiously enough the oldest record of a Baluchi bird must refer to this species and perhaps is the earliest record of the Skua's habits. Early in the year 1604 a Portuguese mariner, one Pedro Texeira, of the coast off Oman 'saw certain 'birds chasing others from natural enmity. The weaker soar upward to escape 'from the stronger and in terror void the contents of their stomachs. The bird 'below hunting the others to this end or from natural spite as fast as this 'happens, opens his beak, catches the same droppings and eats them. I have 'it from natives that on this matter he subsists.'

Pelecanus onocrocotalus onocrocotalus (L.) The White Pelican.

The White Pelican is said to be resident in suitable places such as Khushdil Khan and Saranan in N. Baluchistan by which presumably is meant that birds may be seen there at any time of year; actual records relate however to the months December, February, April (latest 29). I have examined two in the Quetta Museum; one is certainly *onocrocotalus*, the other is smaller (W. 635 mm.) but it is a mounted bird and certainly the wing would measure more if straightened out; it is said to have 22 tail feathers but Pelicans' tails seldom have the full number of feathers; this bird probably is a small female *onocrocotalus*. This species is unrecorded in Mekran where it surely must occur.

Pelecanus crispus (Brüch.) The Dalmatian Pelican.

'Mesh-murg'.

Common in the bays and inlets on the Mekran Coast in winter: it has also been obtained at Sonmeani in Las Belas.

Phalacrocorax carbo sinensis (Shaw and Nodder). The Eastern Cormorant

'Suh-murgh'.

Some Cormorants are always to be met with at Khushdil Khan and Saranan from November to July but apparently they do not breed there. This species is an abundant winter visitor to the Mekran Coast, and is also found in suitable rivers in Central Mekran such as the Mashkai, Nihing, etc. and on the Sirunda Jheel in Las Belas. Latest date April 26.

Phalacrocorax javanicus (Horsf.) The Indian Little Cormorant.

The Indian Cormorant was obtained in the Valley of the Mashkai by Hotson on September 3. It probably occurs commonly in suitable spots in the eastern part at all events of the Mekran, as may also *P. fuscicollis* which is common in the Karachi mangrove swamps.

Anhinga melanogaster (Penn.) The Indian Darter.

Murray records a pair from Pir Chowki at the entrance to the Bolan Pass on March 10 : it may well occur in the Sibi Jheel.

Sula dactylatra melanops (Hartl.) (= *cyanops* auct). The Masked Booby

Hume recorded this Gannet from Gwadar in February and Butler too met with it in May at intervals along the Mekran Coast. He noted that it fed on flying fish and was often in company with *Phaëton indicus.* A young bird which hit the telegraph wires at Charbar on July 31 is in the Quetta Museum so W. D. Cumming informed me. This bird is not known to breed on the Mekran Coast but I think it may possibly nest on one of the Kurya Muria Islands off the Arabian Coasts ; one of these islands (Haski) is covered with guano. Two obtained by Butler on May 14 are in the British Museum. It breeds according to von Henglin on Burda Rebschi, Somali Coast.

Phaëton ætherius indicus (Hume.) The Indian Tropic Bird.

Hume found this Tropic Bird commonly off Ormarra in February and Butler met with it from there to Gwadar in May. I too saw it between Pasni and Gwadar fairly often and again off Ormarra Head in March ; Cumming has noted it there in September. Sir Percy Cox has seen it off Astola in July. Though not yet proved to breed on the Mekran Coast I think it most likely does so on Ormarra Head ; it breeds in the Persian Gulf in March.

Oceanites oceanicus oceanicus (Kuhl.) Wilson's Petrel

Butler saw several of these small Petrels along the Mekran Coast between May 13 and 29 and obtained one ; it was nowhere common but more were seen between Pasni and Charbar than elsewhere. Zarudny too saw it at Charbar on March 12. Cumming has met with it at Ormarra, mostly storm driven birds on various dates between July 7 and September 23. It is of course a non-breeding visitor from the southern hemisphere.

Puffinus persicus (Hume.) The Persian Shearwater.

Hume found the Persian Shearwater at Korebutt on February 15 and obtained it between Gwadar and Muscat on February 21 (the type). Butler noted it commonly along the Makran Coast to Henjam in the Straits of Oman on May 13–20 and remarked on its shyness. I did not actually see this bird off the Baluchi Coast but found it very abundant in the Straits of Oman on March 22. Numbers were seen sitting on the water and in one place we passed a flock of quite 200 but they never allowed the steamer to approach within 200 yards. The type specimen in the British Museum is in full moult wings, etc. ; the breeding quarters are still unknown but must be on islets in the eastern part of the Persian Gulf or on the Arabian Coast.

Birds suggestive of a species of *Prion* have been recorded from the Makran but so far as no specimens have been obtained.

Puffinus tenuirostris tenuirostris (Temm.) The Slender-billed Shearwater.

In the *Bombay Nat. His. Soc. Journal*, xii, p. 767, W. D. Cumming records a Shearwater as *P. chlororhynchus* which had been brought to him at Ormarra, May 1899 ; it had been shot by Mr. Walter Scott of the P. G. Telegraph. Cumming tells me that strong S. W. winds were blowing at the time and the weather generally had been unsettled for two or three days. This Shearwater is now in the British Museum where I and Mr. Kinnear have examined it and it is undoubtedly *P. tenuirostris* and not *chlororhynchus*.

Its breeding ground is unknown. Ridgeway records it from the N. Pacific and cites a specimen from Kotzebue Sound. In the British Museum there are specimens from Japan in May, Behring Island in June, and Bonin Island in May. It has not been recorded from Indian seas before. On March 14 I saw off the Mekran Coast a Shearwater in the distance which was not *P. persicus*.

Threskiornis melanocephalus melanocephalus (Lath.) The White Ibis.

Mr. Ludlow's shikari found a colony of the White Ibis in tamarisks at the Sirunda Jheel in Las Belas and brought back a breeding bird and eggs on July 8, 1915. There is no other information regarding this bird in Baluchistan. Murray lists the Black Ibis for Baluchistan but I know of no certain record.

Plegadis falcinellus falcinellus (L.) The Glossy Ibis.

The Glossy Ibis is not uncommon in suitable spots in the Quetta district on spring passage ; D. Radcliffe says it occasionally occurs in winter. Large flocks visit Khushdil Khan and Saranan in April and May and Meinertzhagen records non-breeders there on July 12 and W. D. Cumming in another year saw them there on June 28. There is one in the British Museum from Pishin on August 27. No records from the rest of Baluchistan where it must occur in suitable spots.

Platalea leucorodia major (Temm and Schleg.) The Spoonbill.

The Spoonbill visits Khushdil Khan on passage ; Meinertzhagen records a flock of 100 there on October 26, a few in November and again on May 17. Cumming saw a flock there on June 28 doubtless non-breeders. A specimen from Nushki in the Quetta Museum was obtained on November 9. Murray records a single bird from Pir Chowki in the Bolan on March 10.

On the Mekran Coast Cumming has noted it at Charbar in winter but at the Sirunda Jheel in Las Belas a few apparently breed in some years as Mr. Ludlow's shikari brought in an egg which was said to be and certainly seems to be that of a Spoonbill on July 8, 1915 ; the nest was in a large tamarisk standing in the Jheel.

Ciconia ciconia (L.) The White Stork.

The White Stork does not appear to be common. St. John noted it as occasional at Pishin and Kandahar in spring and autumn. There is one specimen in the Quetta Museum from Kahan shot on September 12.

It must occur occasionally at all events in lower Baluchistan. Hotson met with it at Magas on the Persian boundary on December 5, where Zarudny has also noted it. Zeugmayer obtained one at Panjgur on August 20. Meinertzhagen records the Kahan bird as *asiatica ;* I have not examined it but Zeugmayer's bird, a female, measures W. 520, B. 154 (Laubmann) and so it must belong to the typical race. *Asiatica* does not seem to be at all a well-marked race.

Ciconia nigra (L.) The Black Stork.

Occasional odd birds occur in the Quetta district in winter ; Meinertzhagen has seen such in October—November and at the end of April. There are specimens in the Quetta Museum from Saranan, November 16, Bolan River, March 18, and Quetta, January 10.

There are only two records from the rest of Baluchistan ; a bird was shot by Cumming on the Vindar R. Mekran coast on November 19 and one was seen by Hotson near Pasni on February 23.

[Zarudny records *Dissoura episcopa* (one obtained and three seen) in Persian Baluchistan but I have no record in British territory. Murray lists the Painted Stork and the Open-bill for Baluchistan Both might wander to Las Belas and Sibi plains but I have no definite record.]

Ardea purpurea manillensis (Meyen.) The Eastern Purple Heron.

Ardea purpurea purpurea (L.) The European Purple Heron.

Purple Herons do not seem to be common in Baluchistan. There is one in the Quetta Museum from Sibi, March 26, which I have examined and belongs to the eastern race *manillensis ;* Meinertzhagen refers to two birds from Quetta and Nushki as belonging to the typical form *A. purpurea purpurea.*

Purple Herons are not uncommon at Ormarra in winter according to Cumming ; they should occur elsewhere in Lower Baluchistan but there are no records and no specimens.

Ardea cinerea cinerea (L.) The Common Heron.

The Grey Heron is not uncommon as a winter visitor in N. Baluchistan and is commoner as a passage migrant in October and again in March and April. Some however spend the summer as Cumming has seen it at Khushdil Khan on June 28 ; there is no evidence of its breeding there. Meinertzhagen has seen this Heron at times far from water searching for lizards and toads.

So far as is known it is a winter visitor to the whole of the Mekran area on suitable streams and pools and is numerous on the coast ; it is said to breed at Kalmat but this is only native information.

Egretta alba (L.) The Large Egret.

The Large White Egret is not very common at Khushdil Khan in winter ; it is recorded thence in February, March and November by Marshall and Meinertzhagen. It occurs occasionally at Kandahar.

Odd birds may be seen from time to time on the Mekran Coast in winter and probably elsewhere. No specimens examined.

Egretta garzetta garzetta (L.) The Little Egret.

Murray records the Little Egret from N. Baluchistan, probably from Sibi district.

Blanford says it occurs occasionally on the Makran coast and Cumming too has noted it at Ormarra.

Bubulcus ibis coromandus (Bodd.) The Cattle Egret.

Noted by Murray at Pir Chowki in the Bolan and at Sibi. St. John records that he got a *bubulcus* at Quetta in May 1887.

Demiegretta sacra asha (Sykes.) The Indian Reef Heron.

The Reef Heron is common along the Mekran Coast and is doubtless resident. Blanford noted the blue phase only ; I have seen both white and blue phases in the Habb River which they ascend to at least fifteen miles from the mouth.

Ardeola grayii (Sykes.) The Indian Pond Heron.

Outside the plains it is only recorded at Chaman where Barnes saw several on July 15, after rain ; in the Sibi plain however it is common and doubtless resident.

In the south Cumming has seen it at Ormarra in winter and I have found it in the Habb Valley in November ; it is probably resident in Las Belas.

Nycticorax nycticorax nycticorax (L.) The Night Heron.

'Machi Giratch' (Bal.)

The Night Heron occurs occasionally in the Quetta Valley ; there are specimens thence in the Quetta Museum obtained in March, April and September. It certainly occurs in winter at Sibi and is possibly resident in that district as Murray records that a small colony were building in Pistachio trees at Bibi Nani in the Bolan on May 21, where hill streams formed a small marsh. St. John recorded that there was a colony in a garden near Kandahar.

It occurs here and there in suitable spots throughout Coastal and Central Mekran but its status is not clear but it is known well enough to have a native name.

Ixobrychus minutus minutus (L.) The Little Bittern.

So far as is known the Little Bittern is a passage migrant in small numbers in the Quetta District, records and specimens relating to August and September April and May. Meinertzhagen however obtained one at Khushdil Khan on July 11, and St. John recorded it as not uncommon at Kandahar in summer.

Cumming informed me that one hit the telegraph wires at Ormarra on October 11, and that he has sometimes heard them passing over at night, Blanford found it in spring at several places on the Persian side of the boundary.

[**Ixobrychus sinensis** (Gmel.) The Yellow Bittern.

Mr. J. W. N. Cumming records that he obtained a Yellow Bittern at Quetta in March 1907 ; both I and Meinertzhagen have failed to find this specimen in the Quetta Museum and so possibly there has been some mistake.]

Botaurus stellaris stellaris (L.) The Common Bittern.

In suitable spots especially near Khushdil Khan the Bittern is a common winter visitor ; Meinertzhagen records that fifteen were flushed in one day when snipe shooting there ; he further states that he has good reason to believe that a pair bred there in 1914, as on June 19, he heard a bird booming and the next morning flushed an adult and a young one just able to fly.

From Lower Baluchistan there is only one record—from Las Belas in March but suitable spots are doubtless few.

Phœnicopterus ruber antiquorum (Temm.) The Flamingo.

The Flamingo visits N. Baluchistan chiefly on passage ; thus Marshall records a large flock at Khushdil Khan in March ; Meinertzhagen in early May and at Saranan in April, while it has been noted at Abigum, Harnai and Nari Bank. A flock which settled on Khushdil Khan were so exhausted that six were captured alive. Cumming has seen a flock there on June 28, but there is no evidence that it breeds anywhere in the north.

It is very common at the Sirunda Jheel in Las Belas and all along the Mekran Coast but I could never hear of anything which suggested that they breed on Sirunda. The status is not clear ; W. D. Cumming was informed by the telegraph officer at Ormarra that in one year some bred near there, probably at Kalmat and this was confirmed by the natives ; it appears however that the swamp there is not always in a suitable state.

Phœnicopterus minor (Geoffr.) The Lesser Flamingo.

W. D. Cumming informs me that he saw one at Ormarra on September 16, 1903. A rare straggler as elsewhere.

Cygnus minor (Keyser and Bl.). (=*jankowskii*, But). Alpheraky's Swan.

A female was shot by Aitken on Khushdil Khan on December 17, 1913 and is in the Quetta Museum.

The evidence at present seems to show that this swan is a separate species and distinct from Bewick's Swan. W. D. Cumming in 1914 took measurements of this specimen and made a coloured drawing of the head and sent them to the British Museum from which this specimen was identified as above by Ogilvie-Grant. Cumming's measurements :—W. 19 in., B from frontal feathers 3¾ in., from gape 3¼ in. Black narrow edging on bill bordering the frontal feather.

Cygnus olor (Gm.) The Mute Swan.

Mute Swans visit N. Baluchistan from time to time. In 1900 when there was quite an invasion of these in N.W. India eight were seen and four shot at Bostan and others were seen on Kushdil about this time where single birds were noted by Meinertzhagen in February 1911, and November 1913.

On January 10, 1900, nine were seen on the Habb River in Las Belas and two obtained by Mr. Jones, I.E.T. ; at Jask in Persian Mekran two were shot by Mr. Griffith on February 11, 1911.

Anser anser (L.) The Grey Lag Goose.

The Grey-lag is a regular winter visitant to the waters of Khushdil and Saranan arriving at the end of October and the bulk leaving in April ; not very seldom however some may spend the summer there ; thus Meinertzhagen records six in the summer of 1913 and Cumming saw some there on June 28, 1923. Mr. A. Gordon informs me that geese always halt at the small tanks at Jhatpat in the Sibi plain at the migrating season, these being the last waters before the hills are reached. Geese were particularly abundant at Saranan in the winter of 1918–1919 in which year water in Sind was reduced to a minimum by failure of the monsoon.

It visits the Mekran Coast in winter but not in any numbers except perhaps at Sirunda.

Anser albifrons (Scop.) The White-fronted Goose.

Recorded by Murray from Sagee.

Dendrocygna javanica (Horsf.) The Lesser Whistling Teal.

There are no records of Lesser Whistling Teal in Baluchistan but it must occur at least in Las Belas. A shikari whom I sent to the Sirunda Jheel at Sonmeani brought back an egg, one of a nest of seven, which he took there on July 13, 1918. The nest was situated in thick reeds. The egg is nearly pure white and measures 47 × 35·5 mm. My identification has kindly been confirmed by Mr. Stuart Baker.

Tadorna tadorna (L.) The Common Shelduck.

The Shelduck is not common but it occurs in winter at Khushdil Khan and once as late, according to Meinertzhagen, as May 19, other records come from Said Hamid, Fort Sandeman, and Nushki.

The only record from S. Baluchistan comes from Turbat in the Nihing Valley where Hotson got one and saw others in the last week of November.

Casarca ferruginea (Pall.) The Ruddy Sheldqck.

A few visit Khushdil and other waters on passage more especially in February and March. To Kandahar and Nushki Districts it is a not very uncommon winter visitor.

No records from Mekran.

Anas platyrhyncha platyrhyncha (L.) The Mallard.

The Mallard is common in suitable places arriving in early September and leaving at the end of March. Three pairs remained in Khushdil during the summer of 1914 and a flock was there on June 28, 1923; such over-summering non-breeders probably led Capt. *Roosmalcocq* to believe that they bred there; I know at all events of no actual proof of breeding beyond the latter's bare statement in the *Proceedings* of the Quetta N. Hist. Soc.

It must occur throughout the Mekran in favoured spots in winter but I only have records from the coast.

Anas pæcilorhyncha pæcilorhyncha (Forst.) The Spotbill.

Recorded from Baluchistan by Murray without comment; the Sibi plain is the only likely place.

Anas strepera (L.) The Gadwall.

The Gadwall is a common winter visitor from late September 15 to early April, a few lingering on till mid-May.

It occurs in suitable spots throughout Central-Coastal Mekran.

Anas penelope (L.) The Wigeon.

Common in winter from late September to April; a pair at Khushdil were seen by Meinertzhagen on June 20.

It occurs here and there throughout the Mekran; earliest October 3.

Anas acuta, L. The Pintail.

The Pintail in the north is chiefly a passage migrant, most passing through in October and November and not recorded after April but at lower elevations as at Nushki, Kandahar and Sibi a good many winter. It is found here and there throughout the Mekran, earliest September 10.

Anas angustirostris, Ménét The Marbled Duck

'Mow' (Bal.)

To North Baluchistan Meinertzhagen considers the Marbled Duck to be a winter visitor in small numbers and a summer visitor at irregular intervals. Aitken saw a pair in June 1913, frequenting a small island in Khushdil and saw others apparently not paired; later on he found an old bird with 14 ducklings. Meinertzhagen saw 6 pairs in June and July 1914 but could get no evidence of nesting.

At Ormarra Cumming tells me that he has met with this bird and it is said to have bred occasionally there in the rain water tanks ; Butler obtained what were evidently eggs of this duck from Moorpatti, north of Ormarra, taken by a native on June 19, 1878 ; the nest was under a babool bush in a large salt marsh.

Ludlow records that he received eggs of this duck with the parent bird taken by his shikari on June 14, 1915 at Sirunda Jheel, Las Belas ; according to his shikari it breeds freely there and the eggs are gathered for eating. The nests were in thick tussocky grass, well concealed and with a tunnel through the grass leading to the nest. Two nests contained 9 fresh and 14 incubated eggs. I too received eggs and an adult thence on July 16, 1919.

Querquedula crecca crecca (L.) The Common Teal.

The Teal is common everywhere in suitable places and is the best distributed of all the ducks. The first few arrive in the last week of August, most come early in September and they have left by the end of April, latest record May 9. It forms 30 to 50 per cent of most ' bags '. Webb-Ware records that between Nok Kundi and Tratoh near Munshi Chah Telegraph Post, he picked up 3 ducks and a Teal with broken wings apparently injured against the telegraph wires and the natives informed him that such birds were often found at this spot at the migratory season.

In winter it is found throughout the whole Mekran, earliest August 31.

Querquedula querquedula (L.) The Garganey Teal.

A few Garganey visit the waters of N. Baluchistan mostly on passage but it is never very common ; it is recorded as late as May 15.

Small numbers visit the Mekran on passage, earliest September 1, last October 23, and again in spring. Some were still on the Sirunda Jheel in the middle of May one year but had gone in June.

Spatula clypeata (L.) The Shoveler.

The Shoveler is common as a winter visitor in the north but more so as a passage migrant ; latest date May 19 and three stragglers were seen on the Zhob River on June 1, 1924.

It occurs on the Mekran Coast as a winter visitor and is very common on the Sirunda Jheel where some were still present in the middle of May.

Netta rufina (Pall.) The Red-crested Pochard.

Though Meinertzhagen records the Red-crested Pochard as an uncommon winter visitor from October to March others have considered it not so rare. St. John regarded it as commoner than the common Pochard as did Radcliffe, and Marshall found it to be one of the commonest ducks in Khushdil at the end of February. Cumming saw some there on June 28, 1923. Probably its status varies in different years according to the state of the jheels, a circumstance I have already noted in the Sind jheels.

It occurs in the Mekran Coast but suitable spots are very few except the Sirunda jheel.

Nyroca ferina ferina (L.) The Common Pochard.

The common Pochard is very common on the few open waters of the north ; it arrives at the end of September and leaves at the end of April. On Khushdil it is perhaps the commonest duck and Marshall records that at the end of February it composed a third of the bag of 110. Some appear to annually over-summer there without breeding as with other ducks ; Meinertzhagen has noted hundreds in May and June and a few in July ; Cumming too saw a flock there at the end of June.

It occurs on the Mekran Coast, no doubt commonly on Sirunda Jheel.

Nyroca nyroca nyroca (Güldenst) The White-eyed Pochard.

A not uncommon winter visitant ; Swinhoe regarded it as the next commonest duck to the Gadwall and says that he flushed many pairs from reeds and tamarisk on water courses from Pishin down to Kirta in the Bolan during May and thought that they might breed there. This however wants confirmation, though it would not be very surprising.

Not recorded in Mekran but sure to occur.

Nyroca fuligula (L.) The Tufted Pochard.

A fairly common winter visitor from late September to April. Meinertzhagen records it as early as August 14 and as late as May 17, Swinhoe also noted it in May and says it was very common at Kandahar and from Pishin to the Bolan in that month,—doubtless still on passage.

It is recorded from the Makran Coast.

Of ducks generally it may be said that the numbers are greatest in October and November and in March and April as the winter birds are reinforced by passage migrants to and from the plains; also opinions will vary as to the commonness or otherwise of any particular species according to where and when the sportsman looks for it and to a less extent perhaps from year to year. The chief duck haunts are Khushdil Khan and Saranan in the Quetta District, Zangi Nanar in the Nushki District and Sirunda Jheel in Las Belas.

Glaucion clangula (L.) The Golden Eye.

A few Golden-eyes annually visit Khushdil from December to March and they are also recorded at Saranan and Zangi Nanar. Not recorded in Mekran.

Oxyura leucocephala (Scop.) The Stiff-tail.

The Stiff-tailed Duck is not very common but is more often met with than the golden-eye and when it occurs quite a flock may be met with; most records relate to the months of November to February but Meinertzhagen records it also in April. Though met with from time to time on Khushdil and Saranan it seems to be a fairly constant winter visitor to Zangi Nanar in the Nushki District whence there are numerous specimens in the Quetta Museum. On waters where they occur they are very local keeping all the time to one particular spot. Further west in Seistan it is common.

Not recorded in Mekran.

Mergus albellus (L.) The Smew.

Fairly common winter visitor in the north, more abundant in some years than in others. Recorded as late as May 19 by Meinertzhagen and May 24, by Murray.

Not recorded in Makran.

Mergus serrator (L.) The Merganser.

One was obtained at Khushdil on April 3, 1902.

A not uncommon winter visitor in small flocks to the Mekran coast keeping much to the bays; it is recorded from Ormarra, Charbar and Jask in December and January. Birds recorded as *Mergus merganser* by Bishop. (S. F. iv, 496) as occurring every winter on the Mekran coast undoubtedly refer to this species.

Podiceps cristatus cristatus (L.) The Great Crested Grebe.

Though D. Radcliffe records the Great Crested Grebe as a winter visitor to Khushdil Khan it undoubtedly in some years at all events breeds there. In 1913 three nests were found on August 12, by Mr. Aitken one containing 5 eggs; the following year a pair were there in June and July but breeding was not established. Nesting doubtless depends on the state of the water. It no doubt occurs in winter also and there is a specimen in the Quetta Museum obtained there in March.

In winter this Grebe is common on the Mekran coast becoming quite maritime in habit; it is generally to be met with in small parties keeping fairly close to the shore and especially to the bays. The earliest date is September 3 and the latest April 23. It is always very wary and wild. W. D. Cumming informed me that when feeding close in these birds sometimes get washed ashore by the breakers. Gwadar and Pasni Bays are particularly affected by them.

Podiceps ruficollis capensis (Salvad.) The Little Grebe.

'Birir' (Brahui).

The Little Grebe is common on all the larger sheets of water in the North; on Khushdil Khan a great many breed. Meinertzhagen records 150 breeding there in 1913 while on June 6, 1914, he found over 100 nests, mostly with 3 eggs several with 4, one with 6 and one with 7. The nests were all floating structures composed of weed foliage, none exceeding 12 inches across the top. On June 8, 1923, W. D. Cumming found a good many nests there containing 1 to 6 eggs.

Elsewhere there are no breeding records ; it occurs on the Mekran coast in winter and Hotson met with it in August and September in S. Kalat and in the Mashkai R. and again at Harbud in Central Makran on April 26.

Podiceps nigricollis nigricollis (Brehm.) The Black-necked Grebe.

The Black-necked Grebe was unknown in N. Baluchistan till 1914 when Meinertzhagen discovered five pairs in the first week of May ; on June 20, in that year he saw hundreds of pairs and examined over 70 nests all situated in about an acre of water 2 feet deep. The nests contained mostly 3 eggs but two had 5 eggs each. The nests, made of weed stalk, were 15 to 18 inches across and attached firmly to the bottom of the jheel, consequently when the water rose after rain a week later all the nests were flooded and the Grebes deserted the locality. The Little Grebes whose nests were floating all survived the flood. I cannot hear that the Black-necked have attempted to breed at Khushdil again since.

On the Mekran coast it is a winter visitor and not uncommon especially in the bays such as Sonmeani and Gwadar.

Colymbus stellatus (Pont.) (=*septentrionalis* auct.). The Red-throated Diver.

There is only one record of the Red-throated Diver in Baluchistan and it has not as yet been recorded in India proper. On November 17, 1901, a bird was brought to W. D. Cumming at Ormarra by a native who had knocked it on the head as it came up close to his ' toney ' ; it was said that several were seen and that a few visit the coast occasionally. The bird is now in the British Museum.

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	British Museum.	Meinertzhagen collection (part).
	Bombay Museum (part).	
	Karachi Museum.	Author's collection.

THE POTTER WASP (*RHYNCHIUM NITIDULUM*)

BY

MAJOR R. W. G. HINGSTON, I.M.S.

(*With two plates and three text-figures*)

PART I

If we examine the ceilings of our rooms we are likely to discover a cluster of pots, four or five perhaps in number, all neatly glued together so as to lie parallel side by side. Each little pot is like a small bird's egg, and all are fixed by their bases to the ceiling from which the cluster projects. It is obvious that these cells are built of mud, but they have not that appearance of well-kneaded pottery which we saw in the work of the Mason Wasp (*Eumenes conica*).[1] This is a rough and granulated structure. Its surface is smeared with viscid mucilage: it is studded all over with irregular nodules of a brown sticky gum.

These pots are the work of a delightful little species, the Potter Wasp *Rhynchium nitidulum* of Smith (see Plate I).

Like *Eumenes conica*, she is remarkably fearless, entering boldly through open doors, hovering confidingly about the room in search of some secluded corner for her nest. Her character is well suited to observation and experiment. Being highly domesticated, she sticks close to her nest. She is so fearless as to remain on her cell while I cut pieces out of its wall. Her patience is untiring. She will face difficulty after difficulty in order to achieve the purpose in hand. Her industry is infinite. The work she toils at is particularly tedious, and she sticks to it the livelong day. Lastly and the point of special importance, this wasp shows wonderful intelligence. Experiment discloses a rational behaviour, so clear, so incontrovertible, that it forces me to modify established views on the capacity of the insect mind.

In this paper I will describe her plan of architecture. The next will be devoted to a series of experiments to illustrate the rational working of her mind.

First a word on her general appearance. She is scarcely larger than a honey-bee, and dressed in unassuming garb. Her jaws are not unlike those of *Eumenes*, a pair of narrow triangular blades that cross in the middle line. Her head is wedge-shaped with black shining eyes. From between these spring stout antennæ. Above them is the punctured vertex studded with tiny pits. Behind comes the thorax, free from fur, decorated in front with a pattern of points and prolonged behind into a pair of spines. Her abdomen is pale and silky. Her wings, which are folded along their length, glisten with a purplish sheen. Though dark, she is patched with silver.

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[1] *Journ. B. N. S.*, vol. xxxi, Nos. 2, 3, 4.

In a velvet pile it grows above her jaws ; it forms a white collar round the front of the thorax, and clothes her abdomen in a satiny gloss.

ARCHITECTURE

Now for her cell, a delicate piece of work. As a rule she fixes her nest to wood. I have seen her build on a plastered wall. This, however, is very unusual. For some reason she has a preference for wood. Thus she often selects a rafter, or perhaps the lintel of an open door, or the under surface of a wooden shelf. She seems to like some structure overhead, for she often builds on a wall or ceiling close beneath the shelter of a beam.

We naturally seek for some explanation as to why she should prefer wood. Her nest will adhere to other materials. Like *Eumenes* she might have chosen metal or glass. The explanation I give is this. Her preference is a relic of an old instinct. Bungalows are recent innovations. There must have been a time when this little architect had to build in more natural sites. In the jungle these sites will be the underside of branches or the hollows in the trunks of trees. No doubt it was there that she originally nested, and wood was the material on which she built. Now she has invaded human habitations. But this trace of the old instinct still remains. She will not have the walls and plaster ; only the beams of wood.

Now let us watch her building operations. I find a nest with two finished cells. The wasp is about to commence a third. In she comes with steady flight. The sound of her approach precedes her, for like *Eumenes* she comes humming through the air. She alights on her nest. Before her are two cells like a pair of eggs side by side. A cleft marks the line at which the cells join, and at the base of that cleft the wasp makes a ridge of mud. This is the first step in construction, the foundation-stone of her third cell. As soon as it is complete she rests for a moment, then, facing her architecture, backs away in flight.

The foundation of the cell is laid and methodical coming and going begins. Now we must watch her with minute care, for every architect in the insect world can teach us something new. Back she comes to continue work. A pellet of mud is in her jaws. Alighting on the nest, she clings to it perpendicularly. Her attitude is inverted, tip of abdomen directed upward, head thrust down upon the rising wall. Quickly and industriously she moulds her pellet. Her tarsi give it lateral support, her antennæ feel the ground before it, her mandibles, one on either side, guide it along the edge of the wall. How well does she perform this difficult operation of rolling a sphere along a knife edge. By her action the globule is lengthened out ; a film of mud is left behind, and this the wasp, with a jaw on either side, deftly moulds into the lamina of the wall. (See Plate II). One other little point. It may seem only a trivial detail, but later I will give it geometrical importance. The wasp, every time she adds a layer, always commences at the middle of the wall and rolls her pellet to one or other end. For instance, she first places it at the centre, then rolls it to the left end. Then she lifts it back to the centre and rolls it to the right end of the wall. Then another lift to the centre and a roll to the left. Then again to the centre and a roll to the right. And so on until the pellet is used up.

Each pellet, of course, adds to the height of the wall; and the wasp, as she swings from side to side, shapes her edifice into a curve. She wastes no time in this delicate work. In one or two minutes the pellet is exhausted. Then she is off. In a minute or two she is back with another pellet which she moulds in a similar way.

Her pellets are composed of the most delicate material, slightly viscid nodules of clay. Only the very finest particles will suit. These she scrapes together, moistens with saliva, kneads into a mortar of pasty consistency, without a particle of grit. Such pellets, when spread out, rapidly harden. The wall is so delicate, only a mere shell, that each addition begins to set before the next is ready to be laid. This is an essential mode of workmanship when raising a rampart of mud. It reminded me of Arab architecture. The Arabs build exclusively with mud. They first raise a wall about a foot in height. This they allow to harden in the sun before adding a second layer. They continue to superimpose layer upon layer, but always allowing one to harden before attempting to apply the next. So it is with *Rhynchium* in her building operations. She likewise raises layer upon layer. While she gathers mortar for the next layer, the previous one becomes firm and dry. Thus the Arab and the wasp are comparable architects. Both work on similar principles, the only possible principles when raising an edifice of mud.

Now the cell is half built in the manner described. Though only a shell, it is fairly firm. In places its surface is marked with lines, faint indications of successive layers. Now, unexpectedly, a change occurs. The mason's manner of workmanship alters. For some reason she begins to build on a different plan. If we have watched with care we may have noticed that on the last few visits the wasp has behaved in an unaccustomed way. Instead of immediately commencing to build, she first pushes herself into the cell. She probes it down to the very bottom. What is her purpose ? At first I am quite unable to understand it. It seems so insignificant. Perhaps it means nothing at all. But there is a reason. A change in method is about to take place, and the mason, when she pushes her head into the cell, is determining the exact moment for the change. For when she pushes in her head she can easily estimate the depth of the cell, or, in other words, the height to which she has built the wall. But at last there arrives a visit when she can push herself into the cell just down to the base of her wings. Apparently this is the depth required: this is the time for the change to take place. For at the next visit, after pushing herself in she does not as before come out immediately. She seats herself inside, abdomen at the bottom, head and thorax above the edge of the wall, and, in this strange attitude, begins to apply her clay. Now let us watch with special care. There is always some good reason for every little fact we see. She is squatting in her half built cell. A jaw and an antennæ are on either side of the wall; her front tarsi are on the edge. She begins to mould. But now she no longer commences at the centre and rolls her pellet to one or other end. Her routine is different. She now commences at one end of the wall, rolls the pellet along to the other end, then rolls it the whole way back again. This is a new mode of workmanship, and she sticks to it till the cell is complete.

I fear that these details are a little complicated. Later we shall see that they have some importance. The point is that there are two phases in construction. First, the mason, hanging head downward, rolls her pellet from the centre to the ends. Then she reverses, sits upright in the cell and rolls from end to end.

I watch her at this work for about three hours. Layer is being superimposed on layer to form a graceful cell. At length it is finished. Her twenty-second visit brings the last pellet. The wall is raised to a sufficient height.

This last visit is of special importance. Her previous ones occupied a minute or two. This last one is a prolonged business for she has to inspect the whole of her work. The exterior is examined: she pushes herself inside, turns about, sits erect in the cell with only the tips of her antennæ outside. She often adds a finishing touch. The inside especially receives attention. A pellet may be cut into the smallest pieces which she uses to plaster small irregularities until the surface is smooth. Then she ceases, satisfied that the work is well finished and sound. A rest is earned after all this toil, so she sits for a little while inside the cell.

For ten minutes she remains idle. Her wall is raised to the full height; it would seem that her work was nearing an end. But such is far from being the case. The structure is a long way from being finished. There are certain urgent and important duties which she must attend to without delay. Her architecture needs thickening and strengthening. The wall is built of the finest clay, plastered smooth, exquisitely thin, a model of the mason's art. But it lacks the most essential quality; it is not yet sufficiently strong to protect the larva that will shelter inside. Parasites exist that could penetrate this chamber, thrusting their ovipositors through the masonry in order to lodge their eggs inside. Grace and delicacy will avail nothing in the absence of security and strength. Hence the very urgent need to thicken this wall of clay.

A short rest, therefore, is all she can afford. Then to work once more. She goes off, but does not, as before, return in a minute. I do not see her for half an hour. Something of special importance must engage her. Otherwise she would not delay so long. At length she returns. The reason for delay is obvious. She has with her not a pellet of mud, but a viscid globule of gum. This has been gathered at some neighbouring tree. What excellent material it is! She is going to strengthen the building with glue.

A process of smearing now begins. It is a slow, laborious business. Three hours were spent in constructing the masonry; for three days she works at smearing the gum. The larger nodules must be cut into fragments, viscid pieces must be severed into tiny parts; all are tenacious and hard to cleave with the simple instruments at the disposal of the wasp. She spreads the substance round the cell aperture, drags it about and smears it on the wall. It maytake her half an hour to exhaust a single pellet of glue. Her industry is indefatigable. Quiet and methodical patience keeps her for days at this tedious work. Unless prevented by stress of weather, she wastes not a moment of time. Each morning finds her gathering gum, and often she sticks to it unceasingly till dark. Dull weather may keep her idle, but sunshine means continuous toil. When a deluge threatens she will not stir abroad, but shelters with-in her cell.

The mucilage is spread on the outside only. None is carried into the cell. The inside wall must be perfectly smooth. She has already cleared it of irregularities. No rough or sticky nodules must be applied to it which might injure the tender grub.

By means of this gum the cell is strengthened. Fragments of masonry are bound together. The whole is hermetically sealed. The mucilage takes time to harden. For months it remains rough and sticky, an excellent protective coat. Not only does it add great strength to the edifice, but also it gives protection against heat, and acts as a kind of external mackintosh to keep out rain and damp. But there remains, I think, a more important function. The glue must protect the larva from parasites. It is not just a glutinous skin. In places it is raised into sticky lumps on which a parasite could scarcely alight. Thus the gum does not only strengthen and shelter : it may also be a kind of glutinous trap.

I have not seen her gathering this substance. But on the mango trunks in the garden are sticky nodules, concentrated oozings of sap, from which the mason must obtain her gum. Think of the tedious labour required, the digging of jaws into the glutinous material, the kneading, the moulding, the shaping into a ball.

Three or four days finishes the smearing. Before passing on let us look at the pot. It is an oval receptacle, distinctly egg-shaped, neatly rounded and broad at the bottom, truncated at the top to receive a lid. Half an inch broad, three-quarters of an inch long ; its widest part is at the middle from where it tapers to either end. The wasp places it horizontally, but in this she shows particular discernment. She gives the cell a slight inclination, raising its mouth above the level of its base. This is a plan to secure safety. The upward tilt will prevent material falling out when provisions are pushed inside.

We now leave the masonry and smearing. I conclude with a detailed table of the work.

Architecture of a Cell of *Rhynchium nitidulum*

Architecture begins

1.	Arr. 2.40 p.m.	5.	Arr. 2.50 p.m.	9.	Arr. 3.23 p.m.
	Dep. 2.41 ,,		Dep. 2.52 ,,		Dep. 3.24 ,,
2.	Arr. 2.42 ,,	6.	Arr. 3.4 ,,	10.	Arr. 3.25 ,,
	Dep. 2.44 ,,		Dep. 3.5 ,,		Dep. 3.27 ,,
3.	Arr. 2.45 ,,	7.	Arr. 3.6 ,,	11.	Arr. 3.29 ,,
	Dep. 2.46 ,,		Dep. 3.8 ,,		Dep. 3.31 ,,
4.	Arr. 2.48 ,,	8.	Arr. 3.10 ,,	12.	Arr. 3.39 ,,
	Dep. 2.49 ,,		Dep. 3.13 ,,		Dep. 3.41 ,,

Architecture—(contd.)

13. Arr. 3.43 p.m.
Dep. 3.45 ,,
14. Arr. 3.46 ,,
Dep. 3.48 ,,
15. Arr. 3.58 ,,
Dep. 4.1 ,,
16. Arr. 4.2 p.m.
Dep. 4.4 ,,
17. Arr. 4.5 ,,
Dep. 4.7 ,,
18. Arr. 4.17 ,,
Dep. 4.19 ,,
19. Arr. 4.20 p.m.
Dep. 4.22 ,,
20. Arr. 4.23 ,,
Dep. 4.28 ,,
21. Arr. 4.37 ,,
Dep. 4.40 ,,
22. Arr. 4.42 p.m. and finishes cell. Dep. 5.3 p.m.
23. Arr. 5.34 p.m. with first load of gum.

Eumenes, immediately her cell is finished, introduces the egg. It is very easy to observe the act. We see her large conical abdomen go down through the cell mouth. But *Rhynchium* is far more reclusive. Her egg-laying takes place in secret, at the bottom of her dark pot. So deep is the cell and she is so concealed in it, that I fail to witness the vital act. But there comes a time when suspicion is aroused. I see her absolutely motionless, rigidly fixed. This must be the moment of emission, when she fulfils the purpose of her life.

Of this, at least, I am quite certain. *Rhynchium* lays her egg when the masonry is finished, but before the smearing of gum. During the short interval between building and smearing I make a hole in the cell wall. This gives light to the dark interior, and enables me to see a single egg anchored to the bottom of the pot. White in colour, of fusiform shape, it is gently curved, about three-sixteenths of an inch long, and fixed by one extremity to the cell wall.

Surely this seems a strange occurrence, this egg-laying in an open cell. For remember that all the smearing must be done before the gate can be closed. This is a work of many days. In the meantime the egg is exposed to any enemy which can enter the gate. Gum smearing, I am sure, is a protective measure ; then why is the egg left open to invasion during those days when the smearing is being done ? Would it not be safer to retain it till all the protective glue was applied ?

It would certainly appear so. The nature of the enemy may explain the inconsistency. Parasites do not enter by the ordinary route. They are not accustomed to open doors. Theirs is a more insidious plan. Armed with ovipositors, they penetrate masonry. Perforation is part of their instinct of attack. Against such devices *Rhynchium* must guard. Her enemy has probably only one way of entrance, by driving its spear through the rampart of mud. It does not understand the open gateway, for it is not its instinct to enter by that route. Consequently the open gate is unimportant provided the cell is covered with glue.

The egg is laid, the wall strengthened. Now comes the storing of supplies. Off goes the wasp in search of plunder. This is a new and brighter occupation, so she swings and hovers in the air. I wait her return. She arrives with a caterpillar in her jaws. She has her victim gripped behind the head with its body supported in her front legs. The caterpillar is a green or brownish species, sometimes of moderate size, but often very small, only about quarter of an inch long. She stuffs it skilfully through the gateway. First pushing it with her head, her body follows, then grasping it farther and farther backwards, she presses it before her to the bottom of the cell. With her vertex as a ram she forces it well down. A little time is spent adjusting it, screwing it about, compressing it, packing it, making it fit economically inside. This finished, she withraws her head and goes off to get more spoil.

If supplies are abundant she may be back in ten minutes. A second victim is added to the store. At other times half an hour is insufficient. In gloomy weather, or when rain threatens, she may not get a capture for the whole day. Again there are times when she can get nothing. On such occasions all her work may be wasted. Famine may force her to abandon the cell. All this foraging is done as quickly as possible. Whenever not engaged at hunting she keeps strict watch on her accumulating store. For example, she always sleeps in the cell, seated on top of the pile of caterpillars, with body bent into the cavity and tips of antennæ projecting outside. Also, when the sky is overhung with clouds she similarly keeps close guard over the store.

Provisioning continues till the cell is full, packed tight to the very mouth. This may require fifty or more caterpillars, they are often so miserably small. And not only must she find them ; they must also be paralysed. Such is the method adopted by her tribe. What infinite labour does not this involve ? Let us make a search for her kind of caterpillar ; if fortunate, in an hour we may find one or two. Yet the wasp has to hunt out fifty or more of them before she can close her cell. We have seen her industry at building operations ; she is equally persistent at pursuing prey.

The stores are in ; they are tightly packed, the chamber is filled to the mouth. The next piece of work is to seal them down, a lid must be placed over the gate. Here we see a rapid operation. The mason brings a pellet of the usual type, and in a minute constructs round the opening a narrow ledge of mud. Sometimes there may be a slight interruption. since the wasp may have to push in her head in order to press the squirming larvæ down. This first ledge closes the aperture partially, but after a minute she brings a second load. This is moulded to the first ledge, and is usually sufficient to complete the lid. Then comes the touching and testing with antennæ to make sure that the work is sound. Without a moment's delay she proceeds to strengthen it. She does not even go off for material, but cuts a little resin from the outside wall and spreads it over the lid. Ten or fifteen minutes are spent reinforcing it, and the gate is permanently closed.

Now surely is the hour of rest. Building, smearing, provisioning are done. But this mason is indefatigable. No sooner is this cell finished than she immediately commences the next.

What a laborious builder to toil so incessantly day after day. The largest nest I have seen contained twelve chambers. If we give an average of five days for the building of each, then the work of the whole nest must have occupied about two months.

Rhynchium is well able to defend her nest. Her attitude within it has protective value. She is bent double ; her back thrust down into the cavity, the end of her abdomen and tips of antennæ turned up into the gate. I bring my finger to the gateway. No sooner have I touched it than out comes the sting which the wasp immediately drives home. For a minute the pain is acute, almost equal to that of the hive bee. But the poison of *Rhynchium* is less lasting. There is no numbness. Her defence is just enough to repel an enemy when it appears at the open gate.

Now that the work is finished, let us see what goes on within the cell.

DEVELOPMENT

Cells are examined at successive intervals. I open the first after the lid has been secured. The wasp has spent three days in provisioning it, but this has not prevented egg-development. The egg has hatched, though the cell remained open. Indeed by now it is a vigorous larva that lies curled at the bottom of the pot. Above it are the caterpillars heaped in a solid mass. The larva has begun to feed. From below it is eating up into the supplies. In this particular cell are forty-one caterpillars, and some have already been devoured. All are of the slender kind, and are pressed firmly together so as to occupy the smallest space.

I open the next cell two days after the lid is sealed. The larva has grown into a huge maggot, stout and fleshy, that almost fills the cell. Pale yellow, curved in outline, its separate segments are visible as rings. Its head end is pointed with curved jaws which are fixed in the tissues of the prey. The hind end is distinctly larger and distended with succulent food. Its length is now three-quarters of an inch, but its body is so neatly curved that it fits economically into the cell. By this time the food is almost consumed. Only two caterpillars remain. One is still alive. I touch it with a pin. Its body bends, limbs twitch, it lies in the same half paralysed state as when first pushed into the cell. The other caterpillar is partially consumed, and the jaws of the larva are embedded in its flank. The others have disappeared. They have passed into the tissues of the larva and a few nodules of stercoral matter that lie at the bottom of the pot.

Two weeks after egg-laying I open a third cell. The larva has changed into a pupa, a miniature of the future wasp. It rests motionless without a sign of life. Eyes are now distinct, antennæ well formed, even the delicate mouth filaments can be distinctly seen. It is pale white, almost colourless, with on either side a dark stump which marks the developing wing.

Three weeks after egg-laying a fourth cell is examined. A well-formed wasp now occupies the chamber, filling the available space. Its head is just within the door with jaws in position to cut through. Now black like the adult, its wings are still unfolded as though not quite ready to emerge. It moves freely in the narrow prison, legs quiver, antennæ tremble, it even protrudes a sting. Nevertheless these movements are hampered since the whole body is enveloped in a skein.

Emergence takes place on the twenty-sixth day. The young wasp excises the lid by gnawing round the edge. She comes out through the opening, but does not immediately take to flight. I observe that for some days she remains on the cluster, often sitting in the cell for hours with only the tips of her antennæ outside. A short flight may be taken at intervals, but her wings are still weak and she soon returns.

At length she disappears. The cell becomes an empty pot with only some refuse inside. Still it is not useless. *Eumenes* builds a cell, closes it, abandons it; but *Rhynchium* will utilize her cell again. She will sweep it of refuse, again lay in it, reprovision it, and close it with a new lid.

But even more. Winter supervenes. *Rhynchium* disappears completely, probably to hibernate in some sheltered hole. Her nest remains stuck firmly to the woodwork and thickly grimed with dust. April arrives. *Rhynchium* awakens from her long slumber to resume the unremitting toil. Unexpectedly I see the nest re-occupied. Surely it is the builder of last year returning to the old cell. I cannot be certain. A wanderer of the same species may have chanced upon it. But *Rhynchium*, as we have seen, is very constant; and I prefer to think that the original foundress remembers the first home.

Now we see how *Rhynchium* gains by expending such labour on her cell. Compared with *Eumenes* the toil is immense. *Eumenes* builds a cell in a few hours, lays in it, provisions it, then sees it no more. But *Rhynchium* spends days at architecture; the building of her cluster occupies weeks. The difference is that *Rhynchium* makes a permanent habitation. She sticks to it throughout the season and may return to it the following year.

GEOMETRY

I come now to some points about geometry. I want to show how the mason measures, how she gets the shape and limits of her cell. There are certain geometrical principles underlying this delicate work.

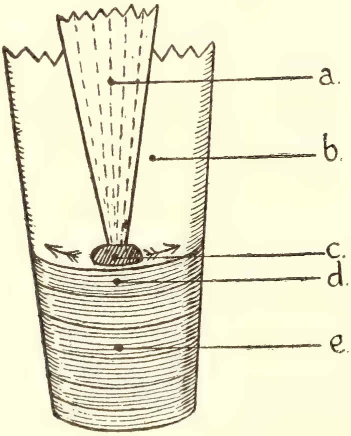
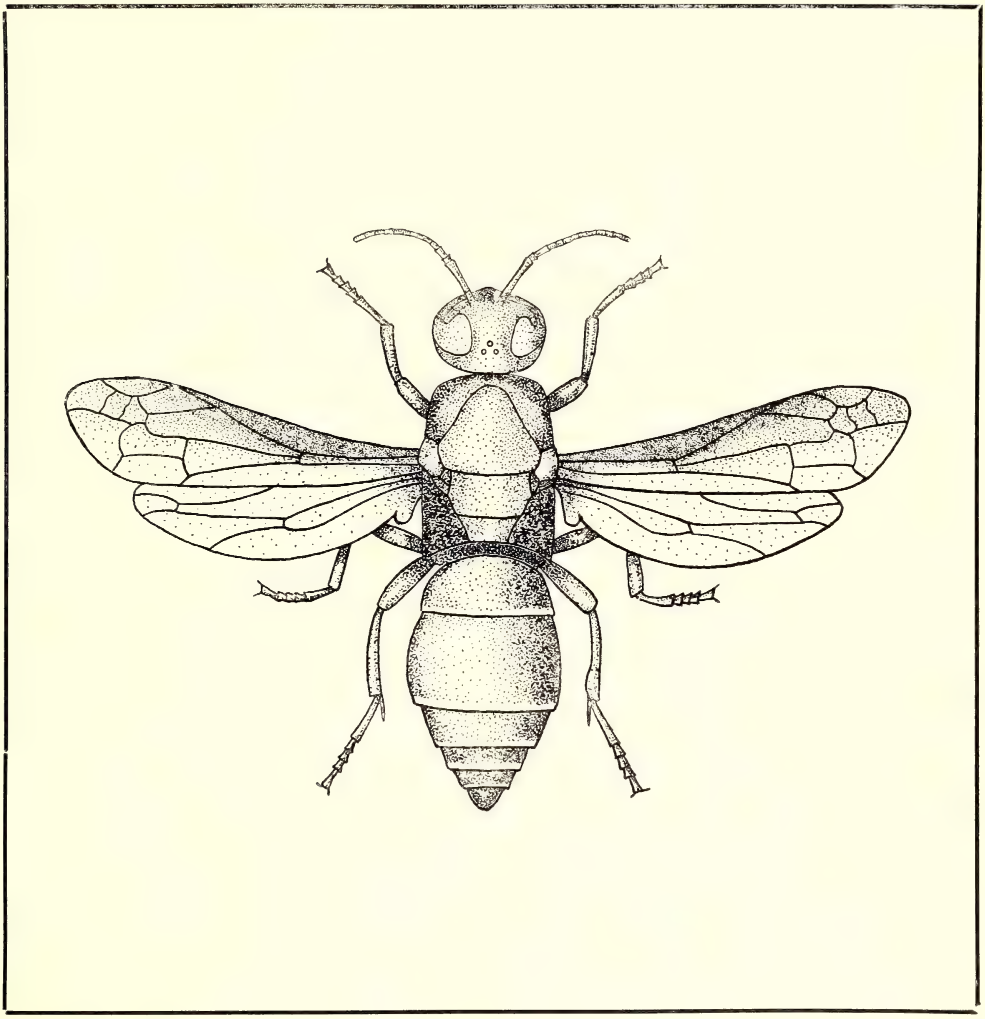
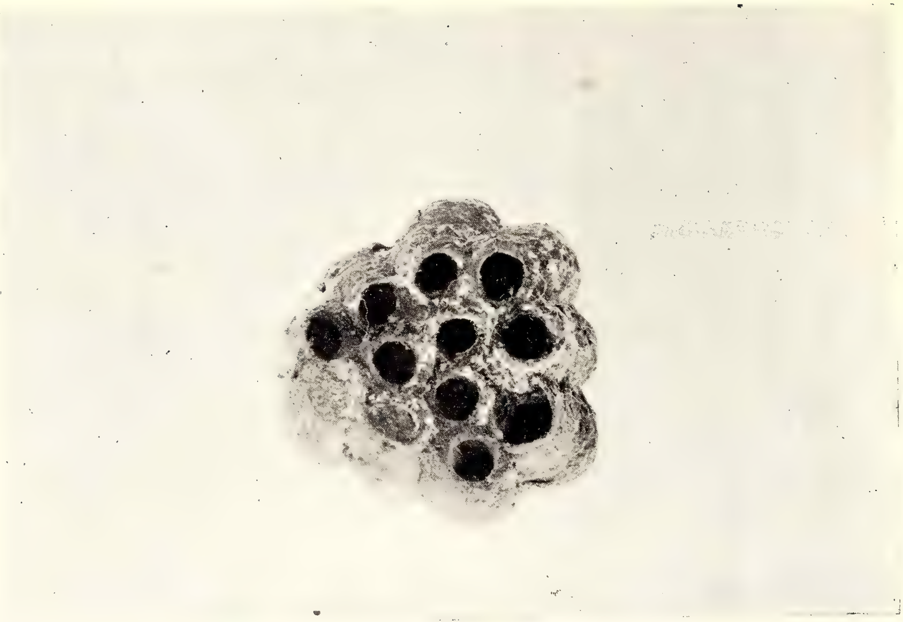


FIG 1. DIAGRAM TO SHOW PENDULUM MECHANISM OF WASP.

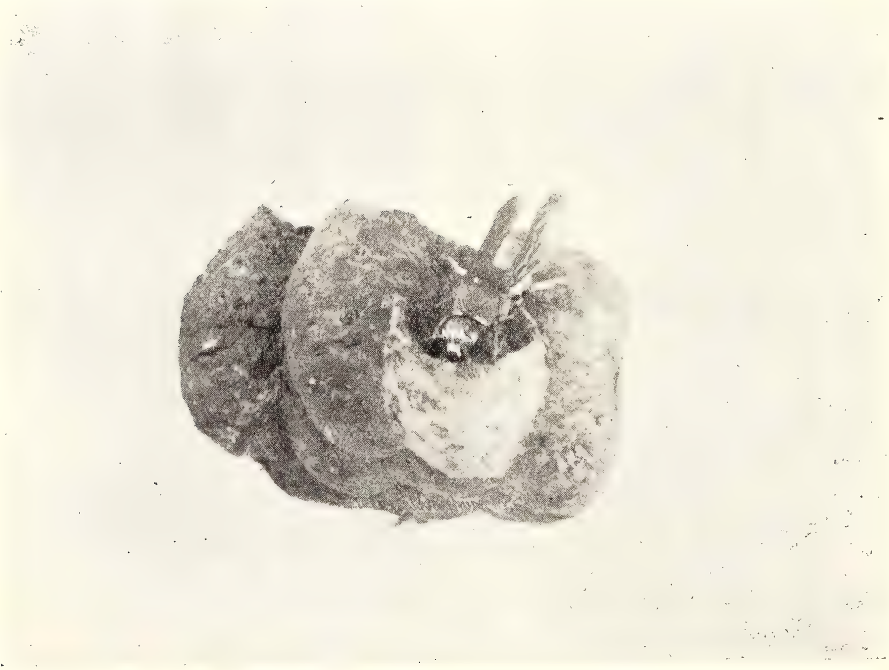
a. Pendulum corresponding to wasp.
b. Surface of completed cells.
c. Pellet at point of pendulum.
d. Top of wall.
e. Wall of cell undergoing construction.



THE POTTER WASP.
(*Rhynchium nitidulum*).



NEST OF THE POTTER WASP (*Rhynchium nitidulum*).



Rhynchium BUILDING LOWER HALF OF CELL.

I recall the method of building. First the wasp hangs head downward, swings from side to side, rolling her pellet from the centre to either end of the wall. Then she reverses, sits upright in her cell and rolls her pellet from end to end. Now I want to explain all this. Why are these attitudes and changes necessary to the shape and perfection of the cell.

First the wasp hangs head downward and swings from side to side. In fact she is a kind of pendulum. But her swings are not quite those of an ordinary pendulum. They not only swing her from side to side, but they also carry her forward in a curve. Thus at first we see a simple mechanism, a pendulum that swings and sweeps a forward curve. (Fig. 1.)

But there is more geometry about it than this. As the wall grows higher the wasp does not retreat upward. In fact the base of the pendulum remains fixed. What then must happen as the wall rises? Since the pendulum will not retreat, then it must tilt more and more forward after each fresh addition to the wall. It will occupy successively the positions 1, 2, 3, 4, 5, as shown in the accompanying sketch. (Fig. 2.) What will be the consequence? The pendulum, after each addition to the wall, will swing through a larger arc than it did on the previous swing. Each successive pellet will be moulded into a larger curve. Hence the capacity of the growing cell will uniformly and geometrically increase.

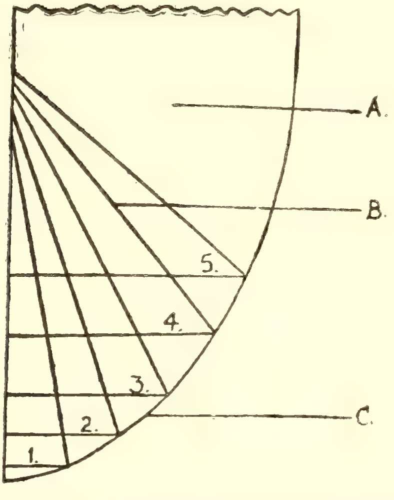


FIG. 2. DIAGRAM TO SHOW FORWARD TILT OF PENDULUM.

A. Wall of cell.
B. Line of pendulum.
C. Front wall of cell.
1–5. Successive levels occupied by pendulum.

Another point. The pellet, as I have said, is at this stage first placed at the centre of the wall, and from there rolled to one or other end. Why is this? When we regard the wasp as a pendulum I think we can explain the act. For, as we have seen, the curve increases at each fresh addition to the wall. But this increase in curve is mainly at the centre; there is little increase at the ends of the wall. There the wall is fairly straight without very much change in curve. Therefore when the mason is shaping her curve she will estimate it better by commencing at the centre instead of at the ends of the wall. By commencing there she tilts out the pendulum to the full extent of the new curve, and then gradually diminishes the arc as she rolls the pellet to either end. This is no doubt an easier operation than if she were to try to draw a curve by one sweep from end to end.

When the wall is half-built the change in method of construction takes place. The mason now gets into her cell, sits erect with head at the edge, and rolls her pellet along the wall.

There must be a reason for this change. I think this is the explanation. The change takes place when the cell has reached its greatest width. During the lower half of its construction the size has been increasing; from now on its width becomes less. In order to effect this change in size the mason has to alter her method of work. The principle of the pendulum, as I have shown, increases the curve at every swing. If she persisted at the pendulum mechanism then her cell would grow larger and larger; it could never graduate into an egg shape. Hence a change of some kind is necessary. See how it works. She gets into the cell, sits upright in it, and rotates from side to side. She is no longer a swinging pendulum, but a vertical pivot that rotates. Her head is bent over the edge of the wall. And as she turns within the cell, she draws out the clay into a curve. Now as the wall grows higher it becomes necessary for her to stretch further upward in order to mould the pellet on the edge. In order to compensate for this she makes each curve a little smaller than the preceding curve. And since the curves become successively smaller, therefore the size of the upper half of the cell grows gradually less.

Nor need the mason now commence at the centre and roll her pellet to one or other end. This was necessary in the lower half, for the curves were then increasing at each swing, and the wasp could do better by taking her measurement from the point farthest away on the curve. But now the reverse happens. The curves are decreasing at every swing. Hence the mason must change her method. Now she measures from the nearest point, therefore commences at one end and rolls the whole length of the wall.

My description may not be sufficiently clear. I will illustrate it by a simple comparison. Imagine a man standing upright with his arm hanging down in front of him. The right arm represents the pendulum, the hand corresponding to the head, the arm to the body of the wasp. Now the hand is going to trace the building movements. First it oscillates from side to side like the wasp laying its first layers. As construction advances, the hand, of course, is raised. It is at the same time tilted forward. As a result it traces a curve and each curve is larger than the preceding curve. Thus the action of the hand is like that of the wasp when building the lower half of her cell.

At length the arm becomes horizontal. That will correspond to the point when the cell is half built. The arm is now out at full length and the greatest diameter of the curve is reached. A change in direction must now take place. The wasp, I have shown, reverses position. From working head down, it changes to head up. A similar reversal occurs with the arm. Follow the hand upward. It gets above the horizontal. The shoulder is still the pivot. But up till now the hand had worked below the pivot: henceforward it will work above. It continues to draw out curves, but, as it rises, it approaches the plane of the body. Consequently each curve is smaller than the one which precedes it. If the hand were building a cell, then the capacity of the cell will decrease. This is a very rough comparison, but it represents the mechanism of the wasp.

Just one more point before we leave the architecture. How does the architect estimate height? How does she know when to cease adding to the wall? It might be thought that the problem would present itself only at the building of the first cell. After that she would have a standard of measurement. The first cell would serve as a pattern, and the others could be raised to an equal height. But a simple observation disproves this. The wasp does not compare heights. There is one plan of measurement which she applies to all the cells. For, sometimes, when adding a cell to the cluster, she may not commence at the same level as she did with the preceding cells. On the contrary, as shown in the illustration (Fig. 3), she begins a little higher up. It will then be observed that the top of this cell is not finished off flush with the preceding cells, but is raised as much above their tops as its point of commencement is above their bases.

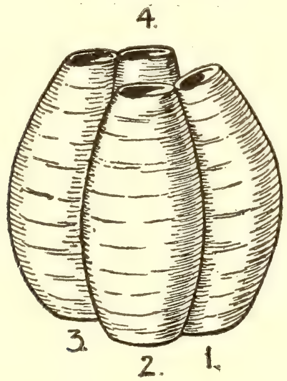


FIG. 3. CELLS OF *Rhynchium nitidulum* AT DIFFERENT LEVELS
Order of construction: 1, 2, 3, 4.

It seems, therefore, that the wasp can estimate the height of each separate cell. Watch her and see the method of measurement. Nothing could be more simple. During the second half of construction she works, as I have said, within the cell. Her attitude is erect, tip of abdomen at the bottom of the chamber, antennæ at the edge of the wall. These are the points by which she measures. She knows that her cell is sufficiently high when the tip of her abdomen just touches the bottom and the tips of her antennæ just reach the gate. The height of a cell is three-quarters of an inch. That too is the length of the wasp between these extreme points. I have frequently shown how insects measure. Here we see one of the simplest mechanisms. The mason employs her own length to measure the cell height.

Honey-bees are the most skilful architects. Working in darkness they shape pyramids and hexagons. They are geometricians in the highest sense. These workers in clay have not their efficiency. Nevertheless they are geometricians. The particular shapes and dimensions of their cells depend on mathematical skill. Different species display different methods, *Eumenes*, by expanding her antennæ widely, can measure out the cell base, by employing them as a pair of dividers can shape a circular door, by using them as a vertical plumb line can determine the cell depth. In *Rhynchium* we observe the pendulum and pivot. Also the simplest of all mechanisms, the measurement of cell height by comparing it with body length.

(*To be continued*)

PANORAMIC VIEW OF A SMALL TORRENTIAL STREAM BELOW DUMPEP IN THE KHASI HILLS. ON THE LEFT OF THE PICTURE ARE [illegible] AND THE STREAM MAKES A BEAUTIFUL CUTTING THROUGH THE ROCKS.

ANIMAL LIFE IN TORRENTIAL STREAMS[1]

[A Public Lecture delivered at the Fourteenth Annual Meeting of the Indian Science Congress at Lahore on January 8, 1927.]

BY

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(*With one plate and ten text-figures*)

SIR JAGDISH, LADIES AND GENTLEMEN,

The subject which I have the honour to bring before you this evening is that of Animal Life in Torrential Streams. I presume that most of you are familiar with what I mean by torrential streams because they are so abundant in all our hills and especially in those hills where the rainfall is high. Just to refresh your memory I shall take you to the Khasi Hills, which are noted for the heaviest rainfall in the world. 'The average annual rainfall at Cherrapunji, a village on the southern face of the hills, is no less than 458 inches. Enormous though this rainfall is, it is little more than half of the maximum on record. In 1861, 905 inches fell, 366 of which were assigned to July alone. The maximum for a single day was, however, recorded in 1876, when 41 inches of rain fell in 24 hours.'[2] It will not be out of place to point out for the sake of comparison that the average annual rainfall of the city of Lahore is nearly 21 inches, which is approximately half of the actual rainfall recorded on a single day at Cherrapunji. The Cherrapunji plateau is admirably drained, and the water is quickly carried off. The streams in the deep gorges swell immensely during and after a heavy fall of rain. Mr. Oldham,[3] who visited one of the streams in these hills after a heavy and sudden fall of rain, describes the scene thus :—' The water had then arisen only about thirteen feet above the level at which it stood a few days previously ; the rush was tremendous—huge blocks of rock measuring some feet across, were rolled along with an awful crashing, almost as easily as pebbles in an ordinary stream. In one night a block of granite, which I calculated to weigh upwards of 350 tons, was moved for more than 100 yards ; while the torrent was actually turbid with pebbles of some inches in size, suspended almost like mud in the rushing stream.' We have here to consider how animals manage to live under such adverse conditions. Besides the rapidity of the flow of water we find that the only kind of food available consists of algal slime covering stones and rocks, for there is little chance of any other type of vegetation to grow as it is liable to be uprooted and carried away by the strength of the current. Very rarely a growth of moss and of higher plants is found in swift currents. Insect larvæ of various kinds are found in fair abundance in these streams and they form a valuable supply of fish food, but it should not be forgotten that the ultimate source of food is the algal slime. Among other conditions that influence the fauna of hill-streams may be mentioned the abundance of shelter, the clearness and shallowness of water during the non-rainy season and consequently intense light during the day-time and lastly the presence of a large quantity of air dissolved in the water.

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[1] The lecture was illustrated with 39 lantern slides, most of which were prepared either from specimens collected by the author or from sketches and photographs made by Babu D. N. Bagchi in the field under the author's supervision.

[2] Allen, *Assam District Gazetteer*, vol. x, p. 30 (1906).

[3] Oldham, *Mem. Geol. Surv. India*, vol. i, p. 174 (1859).

To adapt themselves to such a peculiar environment the animals have modified their entire organization. In the case of fishes,[1] for instance, we notice that modifications have taken place in the external form, the scale covering, the fins, the mouth, the lips, the jaws, the eyes, the gill-openings, the air bladder, the skeletal and muscular frame work and lastly we find that special modifications of the skin have occurred in places. I have not enough time this evening to discuss the entire set of adaptations, but with your permission I shall confine myself to the external form of the animals and to the special structures that enable them to withstand the swiftness of the currents.

In 1891, Nikolsky[2] dealt with the correlation between the shape of the body of fishes and the strength of the current of streams, but unfortunately his work is not available in India and I have not been able to consult it. I have, however, made extensive observations on this point and I propose to give you a summary of my views on the subject.

In general, fishes are boat-shaped, adapted for swift progress through water. They are longer than broad or deep and the greatest width is in front of the middle leaving the compressed paddle-like tail as the chief organ of locomotion. We get such forms in the sluggish waters of our rivers in the plains and in tanks and ponds, but at the base of the hills where streams possess rocky beds and water flows with some rapidity, the fishes that are met with are more or less of a cylindrical form and are provided with a strong caudal peduncle and a well developed tail fin. The cylindrical form probably does not present so much surface to the strong flow of water as the usual form of the fish and the muscular tail becomes a great asset for progression in swift currents. As we go higher up

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[1] Hora, *Rec. Ind. Mus.*, xxiv, pp. 33-61 (1922).

[2] Nikolsky *Rev. Soc. Nat. St. Petersb.* pp. 137-139 (1891).

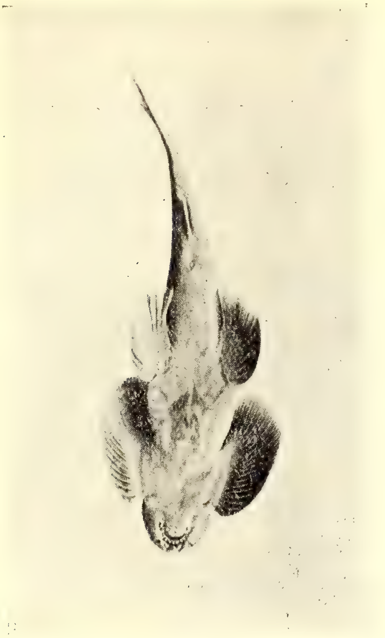

Fig. 1.—*Balitora brucei*, Gray, from Nong-priang Stream below Cherrapunji.

in the hills and study the fish fauna of the torrents, it is found that the form is greatly depressed from above downwards, and in some cases it has become almost leaf-like. The under surface is greatly flattened and has developed adhesive organs for clinging to the rocks in these rapid waters and the tail has become very muscular and whip-like to enable the fish to dart about from one rock to another in swift water. The upper surface has assumed a stream-line form so that it presents less resistance to swift currents.

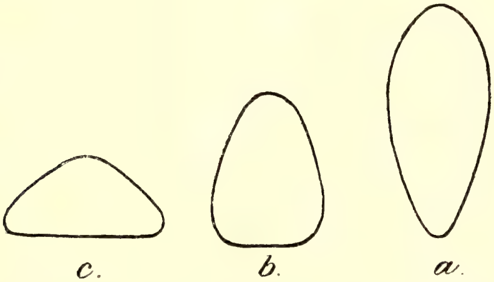

Fig. 2.—Transverse sections of fish showing evolution of form for life in rapid running waters.
(*a*) Section of an ordinary pond fish (*Labeo*).
(*b*) Section of a fish living in moderately swift currents and relatively deeper waters (*Schizothorax*).
(*c*) Section of a typical torrent-inhabiting fish (*Balitora*).

Among fishes I have been able to find two types of adhesive organs,[1] firstly a rounded or elliptical structure with a large callous portion in the centre and a loose membranous flap all round it and secondly an organ composed of grooves and ridges. The former functions as a true sucker by the creation of a vacuum, while the latter in my opinion acts as a mechanical frictional device and prevents the fish from slipping. The true sucker is present in the members of the genus *Garra*, while some sort of a frictional device is present in almost all hill-stream fishes. The latter device possesses one great advantage over the former and it is this:—a vacuum of a certain capacity can have only limited power of adhesion whereas in a frictional device the friction increases with pressure, which under the circumstances is proportional to the rapidity of the flow of water. In streams subject to a sudden rush of water an adhesive apparatus of variable efficiency is very beneficial. Moreover, adhesion by a sucker requires constant exertion on the part of the animal using it, whereas a frictional device acts mechanically, meeting effectively the exigencies of the circumstances.

A powerful sucker occurs in the tadpoles of the section *Rana formosa*. I was afforded an opportunity of testing the efficacy of this mechanism by making a series of observations on the living tadpoles of *Rana afghana* in the Khasi Hills and at Dharmsala in the Kangra Valley. A tadpole was held by its tail and was then placed on a loose piece of stone in water in such a way that its sucker touched the stone. The animal was then lifted out of water by the tail and it was found that the stone was also lifted with the tadpole. By repeating this experiment with stones of different sizes, it was found that a tadpole weighing one-tenth of an ounce could easily, when lifted out of the water, retain a hold on a stone having a weight of about six ounces.

I have here to refer to some very peculiar tadpoles of certain species of the genus *Megalophrys*. Great controversy has raged round the function of the funnel apparatus and a considerable literature has grown round the subject. I made the acquaintance of these tadpoles at Dumpep in the Khasi Hills and found them in abundance in a rapid flowing, rocky stream among weeds and under stones or in crevices in the rocks in sheltered places. To me[2] it at first seemed probable that the two inwardly curved horns of the folded funnel enable the animal to anchor itself among weeds in fairly rapid currents. But further observations carried out in the stream bed itself have convinced me that the peculiar funnel is only a device for gathering plancton on which the animal feeds and that it helps to keep the anterior end buoyant, so that the animal does not knock against rocks if it happens to be swept away by a strong current.

The structural modifications of the fish and of the Batrachian larvae that inhabit our small mountain torrents afford a remarkable instance of parallel evolution or what Annandale and myself [3] have called 'communal convergence.' You must have noticed the great similarity in external form and in the structure of the sucker of *Garra* and of the tadpole of *Rana afghana*. In the former we know that these modifications are the results of a series of gradual changes to be observed both in the post-embryonic development, in individual variability and in specific differentiation. In the larvae of *Rana formosa*, however, we know, so to speak, the finished product of evolution in the highly perfected organ of adhesion. In the case of *Garra* at any rate, we have evidence that these changes have resulted, not through mutation or by any Mendelian segregation of characters, but through a gradual accumulation of small changes.[1] The close correlation between these structural changes and differences in the flow of water in which species and even individuals live is at any rate suggestive. Whether in these particular cases we are witnessing the survival of the fittest in the Darwinian sense, which means the evolution of new structures through the agency of small fluctuating variations, or must accept a frankly Lamarckian explanation, which means the evolution of new structures by the constant use or disuse of the parts affected, only experiment can prove.

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[1] Hora, *Rec. Ind. Mus.*, vol. xxv, pp. 587-591 (1923).

[2] *Ibid.*, pp. 585-587 (1923).

[3] Annandale and Hora, *Rec. Ind. Mus.*, xxiv, pp. 505-509 (1922).

The Gastropod molluscs that live actually in rapid waters, such as species of *Paludomus*, or which live on rocks at the sides of streams subject to a sudden rush of water, such as *Cremnochonchus syhadrensis*, *Neritina perotettiana*, *Lithotis rupicula* and *Turbinicola saxea*, have solved the problem of existence in their particular habitat by the greatly increased size of the foot and a consequently increased power of attachment. In the case of *Paludomus* the upper whorls are usually worn and the shell comes to resemble the small rounded pebbles among which it usually lives. Among the Gastropod molluscs, however, special mention may be made of the various species of the genus *Ancylus* which inhabit swift currents and are limpet-like in form. They probably stick to stones or other objects by the creation of a sucker in the strict sense of the term. Certain bivalves, such as *Corbicula*, are also found in rapid water, but they manage to live during floods by seeking shelter under rocks or by burrowing in sand. One species of bivalve from the Surma Valley,[2] Assam, has developed this habit to an extraordinary degree. It lives, firmly anchored by its extensive foot, in regular burrows formed either in hard blue clay or in friable sand-stone rocks. It has thus avoided the dangers of swift currents in a most ingenious way. I shall have occasion to refer again later to this mode of life in hill-streams, when dealing with the insect larvae.

Leeches are also met with in hill-streams but you are probably aware that these animals are provided with well-developed suckers. Those from rapid waters have these suckers better developed. I also found a colony of Polyzoa, or moss-like animals, in rapid water in the Kangra Valley.[3] This is an encrusting form, so that once it is attached to stones it needs no further specialization. The occurrence of Polyzoa in running water is a rare phenomenon and Annandale observed it only once, in *Plumatella fruiticosa*, in a small jungle stream in Travancore. My specimen from the Kangra Valley also belongs to the same species but it is remarkable that only the form *stricta* of this species occurs in running water, and it seems probable, as Annandale has pointed out, that this form is found only in those places where there is reason to suspect a lack of minute life and, therefore, of food.[1] I have collected a number of Turbellarians or flat worms in hill-streams, but have not so far made a special study of these animals. They are broad, flat and leaf-like and encrust stones and rocks in rapid waters, and Prof. Stanley Gardiner of Cambridge University has very kindly informed me in a private communication that these forms also possess specially modified clinging organs.

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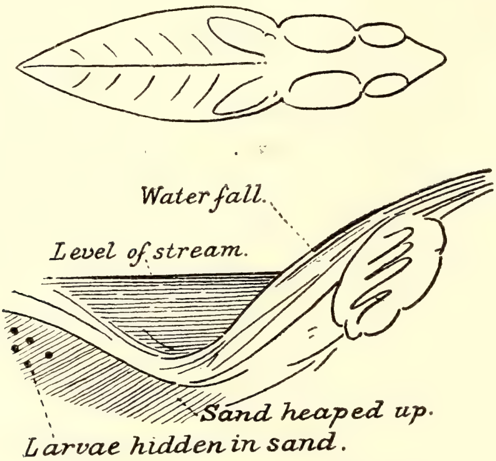
[1] Hora, *Rec. Ind. Mus.*, xxii, p. 640 (1921).

[2] Hora, *Journ. Asiat. Soc., Bengal* (in Press).

[3] *Ibid.*

Insect larvae of various kinds occur in mountain torrents in large numbers and are remarkably well adapted for life in such situations.[2] I propose to deal with the various groups one by one.

The dragonfly larvae of our torrential streams can be divided into four groups. The first group bury themselves in the sand at the bottom of pools in streams. These are generally found to belong to the Gomphines with a torpedo or stream-line body adapted for pushing forward through sand or facing heavy currents. The legs are short and adapted for burrowing. These larvae frequent particular spots, usually in front of the foot of a falling column of water, where the water has scoured out the sand and heaped it up down stream. I have illustrated this type by *Macrogomphus wynadicus* and *Megalogomphus hameyngtoni*. The siphon-like tube at the posterior end of



(From a drawing by Col. Fraser)

Fig 3.—The form and habitat of Gomphine larvae.

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[1] Annandale, *Faun. Brit. India, Freshwater Sponges, Hydrozoa and Polyzoa*, p. 219 (1911).

[2] Musgrave and Campbell, *Austral. Mus. Mag. Sydney*, iii, pp. 28-31 (1927).

the abdomen of the former is the only part of the larva which projects from the sand. These larvae are rectal breathers and hence the utility of such a device is perfectly obvious.

The second group includes limpet-like forms such as *Ictinus* and *Zygonyx* which are actual water-fall dwellers. The belly is absolutely flat and is very broad, the back is highly arched like a limpet and slopes steeply away on either side. They live on rocks and are able to hold their own against the heaviest torrents. It has been believed that adhesion is due to the close application of the ventral plates to a rock and by the creation of vacuum by contraction of the plates. Personally I have no idea as to how far this view may be correct but my examination has revealed the presence of definite adhesive pads on the ventral plates ; these pads are very much like the lamellae on the sucker of *Echenei* or the ship holder and are provided with spines, thus forming an efficient frictional device. *Ictinus* and *Zygonyx* belong to widely-separated families but from a similarity of habitat have become modelled alike. The former are Gomphines and the latter Libellulines but the resemblance is so close that an expert might be deceived. These two provide another instance of communal convergence.

The third group comprises root-dwellers and these are found clinging to roots along the river banks, swayed from side to side with every eddy of the current. These are long, thin, attenuated larvae resembling stick-insects. They lie close to the roots and thus offer a very small surface to the force of the current. I shall mention here two instances illustrating this group, firstly *Matrona basilaris*, a Calopterygine larva, and secondly the spidery-legged *Macromia ida* a Libelluline larva.

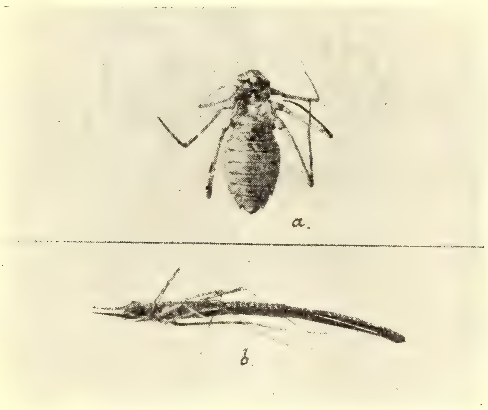

Fig. 4.—Root-dwelling dragonfly larvae of torrential streams.
(*a*) *Macromia ida*, Fraser ; (*b*) *Matrona basilaris*, Selys.

There is yet a fourth group which is found hidden amongst the leafy debris collected in deep pools in the course of mountain streams. These are broad, flat and leaf-like.

I must express here my great indebtedness to Lt.-Col. F. C. Fraser for sending me valuable notes regarding the habits of the fly larvae of hill-streams and for supplying me with specimens for illustrating this lecture.

Among the mayfly nymphs we find adaptations similar to those that I have already shown you in the dragonfly larvae. Here we have burrowing larvae such as those of *Palingenia* and *Polymitarcys;* creeping larvae that anchor themselves on water weeds and stones in swift currents and lastly those larvae that possess flattened bodies. These last are of the *Ecydurus* and the *Heptagenia* type and are usually met with either on the under side of stones in swift current or on the upper sides of rocks in deeper waters. Some of these larvae, both of the clinging type, which are long and thin, and of the flattened type which possess a limpet-like form, frequent bare rocks in very rapid waters. In all these forms very strong claws are developed for grappling on to the rocks and stones, but in certain larvae of the flattened type that frequent the upper sides of rocks in strong currents the tracheal gills are greatly enlarged and are arranged in such a way that a complete or a partial sucker is formed on the under side of the animal when needed. In addition they are provided with a series of pads beset with spines on the under surface of the tracheal gills. A combination of these two devices makes the under surface thoroughly non-slippery. The highest development of the sucker is reached in the nymphs of the archaic genus *Prosopistoma*, which, according to Eaton [1] 'is exceptional in having the body oval in outline, convex above and flattened beneath ; and it possesses the faculty of adhering firmly by suction, like a limpet, to stones.'

The stone-fly nymphs usually occur in situations similar to those of the mayfly larvae of *Ecydurus* and *Heptagenia* types. They are fairly common, but always on the under side of the stones, in such places where water runs swiftly over a bed of comparatively small pebbles. The nymphs cling closely and lie flat with legs outspread ; they hold on by means of stout paired claws that are like grappling hooks. Their legs are flattened and laid down against the stone in such a way that they offer little resistance to the passing current. The efficiency of the claws for grappling can be readily tested by allowing a larva to crawl on the back of one's hand or on one's arm. They are very quick in their movements and are known to be the worst carnivores of torrent fauna.

The larvae of the *Trichoptera* or the so-called caddis-worms are found in all sorts of inland waters. They build a shelter for themselves and drag it along wherever they go. The case or shelter is held fast by the two very powerful, hooked claws at the hinder end. Several of them are found in rapid waters where they have devised several interesting ways to withstand the rush of water. Some fasten their cases to rocks in swift currents by means of their salivary secretion in such a way that a stream-line form is presented to the current and the animal lives with the open end of the case up-stream. The case itself is greatly flattened on the under surface to come in close contact with the support. Some weave a sort of a conical web on the rocks or on water plants growing in swift currents and themselves sit comfortably in its pointed portion and wait for any booty that the current may bring into their web. I have observed certain others that live on the under side of rocks in swift water forming a barricade of small stones and spinning a web over it with a hole for the animal to come out through. Most remarkable among these worms are those in which the case has taken a limpet-like form and the animal is thus enabled to cling fast in very rapid waters.

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[1] Eaton, *Trans. Linn. Soc. London. Zoology* (*2*), iii, p. 13 (1888).

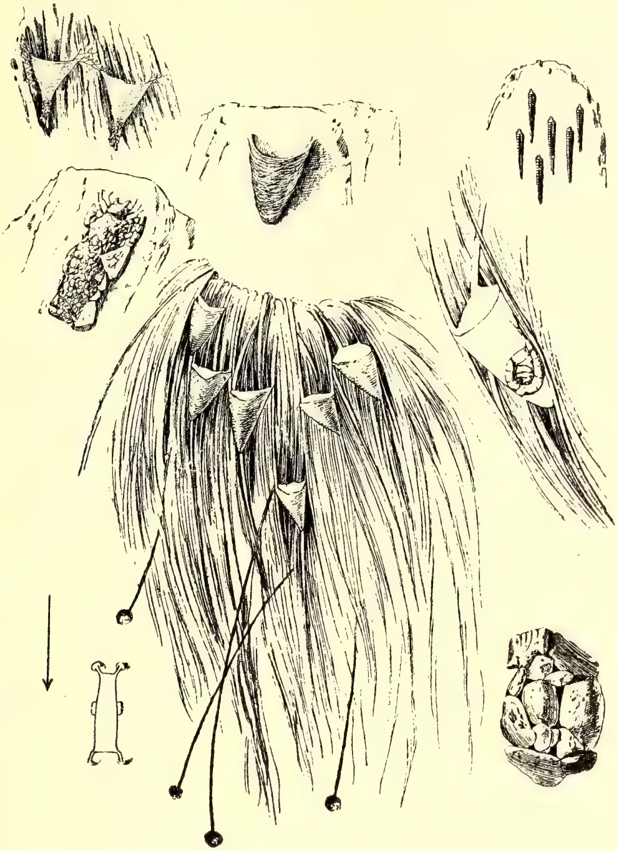

Fig. 5.—Trichopterous larvae (caddis-worms) from torrential streams in India.

From among beetles I want to draw your special attention to the remarkable larvae of the genus *Psephenus*, commonly known as 'water-pennies.' They occur in swift streams chiefly on the underside of stones and are known to be especially abundant in the rapids of Niagara, but are by no means uncommon in our Himalayan streams from Darjeeling to the Kangra valley and in the Khasi Hills. They are greatly depressed from above downwards and are almost scale-like in appearance. Their form is either rounded or ovoid. The whole of the under surface of the body appears to act as a sucker and it is very difficult to dislodge these larvae with the fingers.

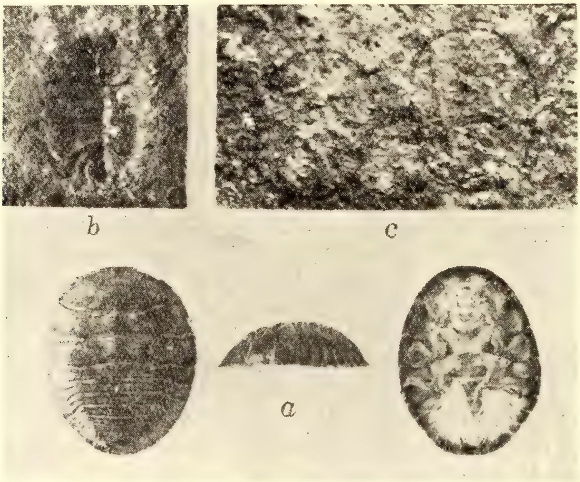

Fig. 6.—*Psephenus* larva and pupa from the Kangra Valley, Punjab.
(*a*) Three views of a larva; (*b*) Pupa soldered on to a rock; (*c*) Scars left on a rock after the pupal skins are washed away.

The pupae are more or less similiar to the larvae, but they are soldered down to the rocks. After the emergence of the beetle, when the pupal skin becomes disintegrated and is washed away, a black oval ring is left to mark the place. The black outline shows the marginal region along which they had been soldered down to the stones. This sort of a permanent adhesion is effected by the secretion of some sticky substance, which leaves black marks on the stones.

The beetles of the family to which *Psephenus* belongs are found for the most part near running water or clinging by means of their strong claws to water plants or other submerged objects. Certain other beetles have also been observed in similar circumstances, but they do not possess any special organs of attachment other than their powerful claws. The under surface is more or less flattened in all beetles, but it is more so in those that frequent rapid waters.

Among the *Diptera*, *Nematocera* or the midge-like flies, there are two remarkable families, whose larvae live on bare rocks in the course of very rapid waters. I here refer to the blood-sucking black-flies (*Simuliidae*) and the net-winged midges (*Blepharsceridae*). A *Simulium* larva is a small bag-shaped, cylindrical creature somewhat broader at the posterior end. It is usually found sticking by its so-called posterior sucker either to water plants that grow in swift currents or to the upper surface of rocks and stones in rapid waters. It hangs from its support with the head pointing

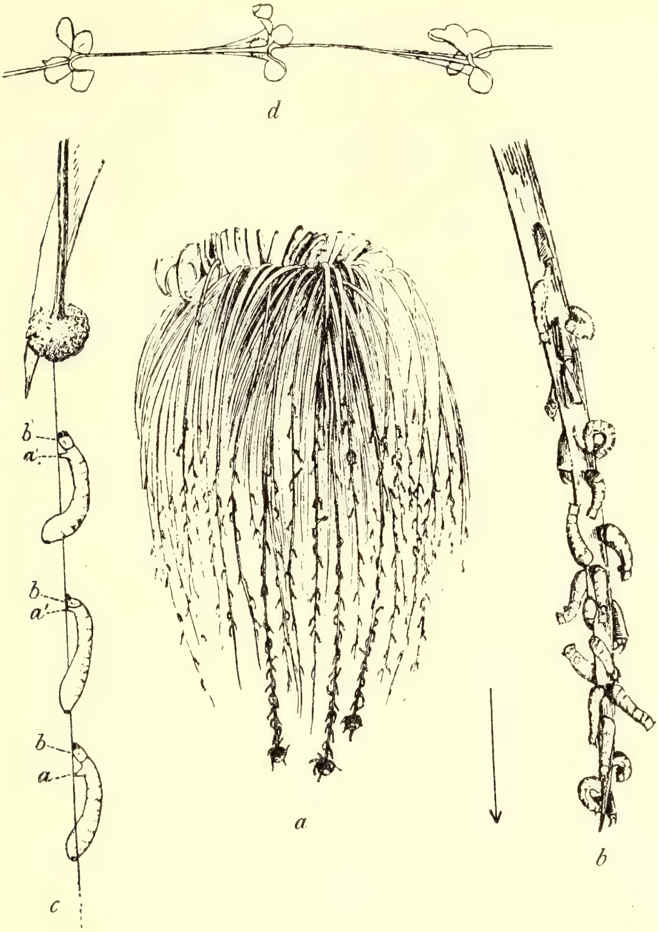

Fig. 7.—The larvae and pupae of the blood-sucking black-flies' (*Simullidae*).

(*a*) Larvae and pupae on water weed (*Eriocaulon miserum*) growing in very swift current. (The artist has not been able to do full justice to the number of larvae that are usually found in similar situations.)

(*b*) A blade of the same weed showing larvae and pupae in various postures.

(*c*) Shows a larva crawling back to its support.

(*d*) A portion of the track left behind by a *Simulium* larvae on a glass slide (highly magnified).

down-stream in such a way that a stream-line form is presented to the current. Its posterior appendage, or the so-called sucker, has received considerable attention. The earlier writers considered it a sucker in the same sense as that found at the posterior end of a leech, but Tonnoir [1] not finding any muscles inserted in the middle of the disc doubted its utility as a sucker. Dr. Puri [2] who has quite recently published a monograph on the structure of these larvae, has found definite muscles and has observed ' that they contract when a larva fixes itself by its posterior end.' He further points out that ' in spite of the presence of these muscles the larva cannot fix itself effectively without the further help of the sticky salivary secretion.' A very close study of the habits of these larvae enables me to say that the posterior appendage does not act as a sucker, and the larva fixes itself with the help of hooks and the salivary secretion alone. The larva spins out this salivary secretion into a fine silk thread which is very sticky and very strong. I have watched a fairly large specimen of a mayfly nymph struggling to free itself from the silk thread of a *Simulium*, and it has been observed time and again that if a larva is disturbed it lets go its hold and is carried away by the current for some distance but all the time it keeps hanging on to its support by a fine silk thread. By means of this rope-way the larva can crawl back to its former support. The consistency of this thread must be very remarkable for it can bear not only the weight of the animal when it presents an inverted stream-line form to the current (for the larva climbs with the head pointing up-stream), but also the tremendous rush of the current at one and the same time. The posterior ' sucker ' is provided with a rosette of hooks and the function of these hooks and, therefore, of the ' sucker ' is to grip firmly a cluster of silk threads which the animal secretes on the spot where it wants the posterior appendage to be fixed. The necessity for the presence of muscles in connection with this appendage is obvious, for in order to disengage the hooks from the salivary secretion a strong and sudden muscular pull is needed. The muscular action noticed by Dr. Puri at the time of the attachment of the sucker is a manipulation on the part of the animal to enable it to fix its hooks properly in the secretion.

Needham and Lloyd [3] give an interesting account of the general habit of the *Blepharocerid* larvae. They say that though ' Not the most limpet-like but yet the best adapted for hanging on to bare stones in torrents is the curious larva of the net-veined midge, *Blepharocera*, an inhabitant only of clear and rapid streams. The depressed body of this curious little animal is equipped with a row of half a dozen ventral suckers, each of which is capable of powerful and independent attachment to the stones. So important have these suckers become that the major divisions of the body conform to them and not to the original body segments. On these suckers, used as feet, the larva walks over the stones under the swiftest water, foraging in safety where no enemy may follow.' They further observe that ' the naked pupa is found in the same situation and is attached by one strongly flattened side to the supporting surface.' These larvae are indeed the most highly specialized of all the torrent-inhabiting animals, but in a suitable habitat they are found in countless numbers. I have observed the young larvae in comparatively calm waters either at the side of the strong current or actually in places where the current does not run very fast. There appears to be a regular correlation between the stage of growth of a larva and the rapidity of the current in which it lives. The pupæ were also found along with very young larvæ or in small nooks and corners where they were comparatively safe. They usually occurred on vertical rocks over which the water fell and thus kept them moist.

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[1] Tonnoir, *Ann Biol. Lucustre*, xi, pp. 163–172 (1923).

[2] Puri, *Parasitology*, *Cambridge*, xvii. pp. 311, 312 (1925).

[3] Needham and Lloyd, *Life of Inland Waters*, p. 368 (New York : 1916).

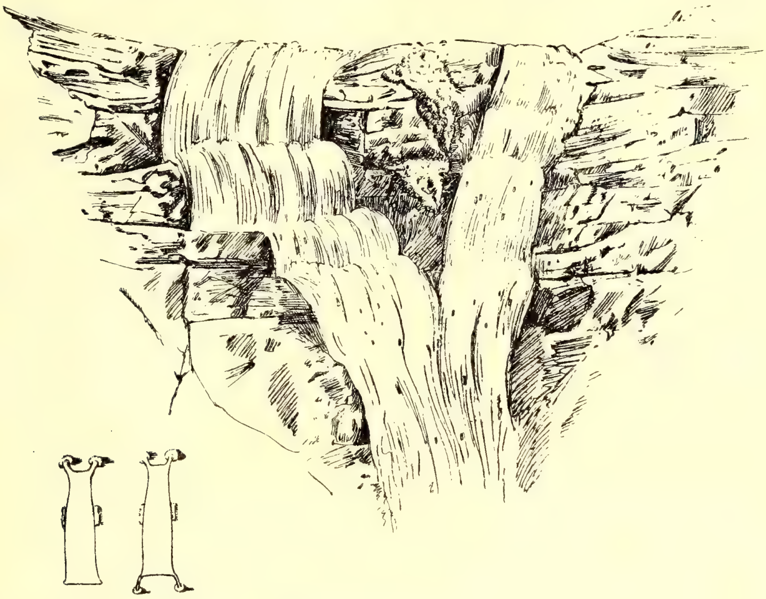

Fig. 8.—Habitat of *Blepharocerid* larvae and caddis-worms.

At the head of the waterfall a large number of larvae of the net-veined midge were found, while on the sides of rocks in the course of the fall were found caddis-worms in their peculiar cases.

Ladies and gentlemen! You must yourselves have noticed from what I have said, and from what has already been pointed out by Needham and Lloyd,[1] that ' the impress of environment is seen not only in the form of a living animal but also in that of the non-living shelter that it builds. In this there is a parallel of form in the secreted shell on the back of the snail, *Ancylus*, and in the manufactured shell of the back of the caddis-worm, *Helicopsyche*. One would have to search widely to find better examples of the effects of environment in moulding to a common form these representatives of many groups of very diverse structural types. Two of them, at least, were sufficiently like lotic mollusca to have deceived their original describers. *Psephenus* was first described as a limpet and *Helicopsyche* as a snail.'

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[1] Needham and Lloyd, *op. cit.*, p. 374 (1916).

With your permission may I avail myself of this opportunity to thank the successive Directors of the Zoological Survey of India who have given me every possible encouragement and facility to pursue the study of this subject. I am especially indebted to Major R. B. Seymour Sewell, who very kindly allowed me to tour in the Kangra Valley, the Khasi Hills and the Darjeeling Himalayas in the course of the last year to check my results gained from the study of the 'lotic' fauna in previous years. It has thus been possible for me to present to you this evening fresh views on the various aspects of the life of the animals that inhabit the swift currents of our torrential streams.

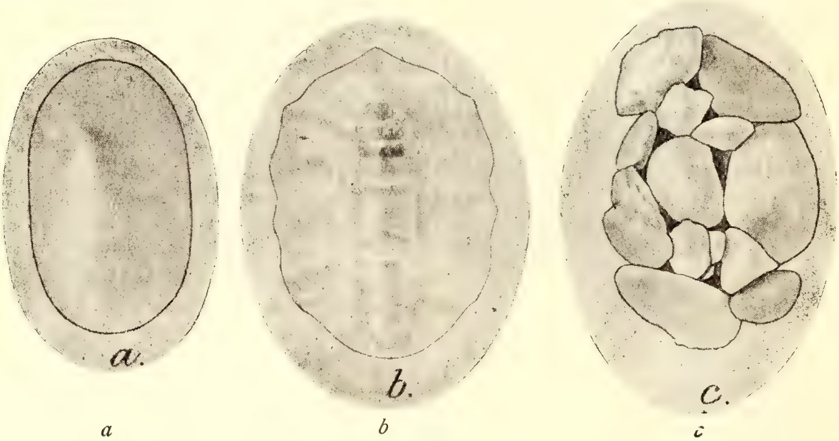

Fig. 9.—Showing impress of environment on the form of the non-living shelter.

(*a*) *Ancylus*, a snail ; (*b*) and (*c*) cases of two caddis-worms from Pashok in the Darjeeling District.

ADDENDUM

In my public lecture I had to content myself with a few typical instances illustrative of adaptations for life in rapid waters. In this note I propose to complete my account of 'Animal Life in Torrential Streams' by citing examples from three other groups of insects whose larvae, pupae or adults frequent swift currents.

Caterpillars of certain moths of the sub-family *Hydrocampanæ* are known to lead an aquatic existence. Our familiar examples[1] of such larvae are inhabitants of sluggish or stationary waters ; they make a shelter out of the leaves on which they feed and which they fasten together by means of silk. In recent years, however, a third type of aquatic larvae has been found in rapid-running streams. In 1908, Muir and Kershaw[2] found caterpillars of *Aulacodes simplicalis*

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[1] Miall, *The Natural History of Aquatic Insects*, pp. 226–235 (London) : 1895 ; Needham and Lloyd, *Life of Inland Waters*, pp. 218–220 (New York : 1916); Imms, *Text Book of Entomology*, p. 492 (1925) ; Needham in Ward and Whipples' *Fresh Water Biology*, p. 903 (New York : 1918).

[2] Muir and Kershaw, *Proc. in Trans. Ent. Soc. London*, pp. xl–xlv (1909).

Snell in a very fast current at Lappa, a mountainous island on the western side of the harbour of Macao in China, and Lloyd[1] has described larvae of *Elophila fulicalis* that live on stones in rapid streams of Ithaca, New York. I have found larvae of similar habit both in the Darjeeling Himalayas, 2 miles below Pashok, and in the head waters of the Nerbadda River. These larvae weave an irregular shelter of thin-spun silk which is attached to a piece of stone at irregular intervals leaving a series of holes for the larva to come out through for the purpose of feeding, etc. Each larva at the time of pupation manufactures a dome-shaped pupal shelter under some portion of the larval cover and this it fastens very carefully to the rock leaving rows of marginal openings on either side for free circulation of water and air through it. When the pupal case is completed the unused portion of the larval shelter is washed away. The pupal case shows a remarkable similarity to the limpet-like non-living shelters to which I have referred to already.

On reference to the Museum Collection I have found similar caterpillars collected by Dr. F. H. Gravely at Hoshangabad and Pachmarhi in the Central Provinces and provisionally referred to the genus *Aulacodes*. Dr. B. Chopra collected a number of these larvae at Kurseong in the Darjeeling Himalayas. All these are

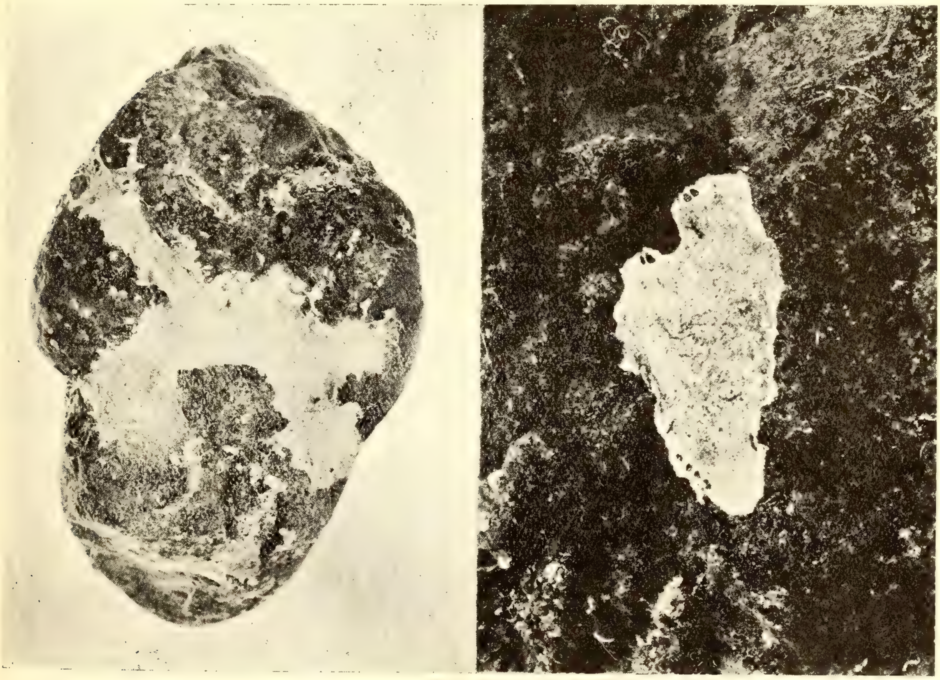

Fig. 10.—Larval and pupal shelters of a Pyralid moth.
(*a*) Larval shelter ; (*b*) Pupal case.

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[1] Lloyd, *New York Journ. Ent. Soc.*, xxii, pp. 145-152, pp. iii, iv (1914).

flattened from above downwards and are provided with branchial filaments for aquatic respiration.

Drs B. Chopra and H. S. Rao have drawn my attention to certain creeping Water-Bugs (Family *Naucoridæ*) recently collected by them in Burma from underneath stones in swift currents. These insects are flat-bodied and are oval in outline. The femora of the front legs are greatly enlarged and are fitted for grasping, while the middle and hind legs are suited for crawling about. The under surface of each half of the posterior segments is provided with a group of strong spines, which probably act as adhesive pads in the same way as the spines on the sucker of *Echeneis*.

Neuropterous larvae of various kinds are found in swift currents, but they are not by any means specially modified for such an existence. They live under stones and are not affected by the rapidity of the current. Several other kinds of beetle and dipterous larvae are found under stones and are not modified for stemming the swiftness of a current except for the fact that they possess very strong claws.

I want to express here my great indebtedness to Mr. S. Ribeiro for the valuable assistance he has rendered to me in sorting out my insect material and in looking up references for me on various points.

WILD ELEPHANTS IN THE UNITED PROVINCES

BY

F. W. CHAMPION, I.F.S.

(*With four plates*)

All along the forest belt at the base of the United Provinces' Himalayas wild elephants are to be found in small numbers and a few also occur in the terai forests of Oudh, as well as in the Zemindari forests of Bijnor and elsewhere The largest number live in the dense bamboo forests of the Garhwal Bhabar, in the Lansdowne Forest Division, where there are probably about fifty permanent residents, but elsewhere the numbers are smaller and the total head of wild elephants in the whole of the United Provinces probably does not exceed some 250 individuals, divided up into a number of small herds, with numerous semi-solitary tuskers and maknas scattered about in the forest areas. A fairly large herd has recently appeared in the terai forests of the Pilibhit Forest Division, in Oudh, and it is probable that this herd has recently emigrated into British India from the neighbouring forests of Nepal.

In the earlier part of the last century these wild elephants were greatly persecuted by sportsmen, particularly in the neighbourhood of Dehra Dun, and it is probable that they were saved from annihilation only by the Elephant Preservation Act of some fifty years ago. This Act prohibits the shooting or killing of elephants entirely, except in the case of proclaimed rogues, and it is a great pity that some of the other species, such as rhinoceros, were not saved from destruction in the same way. Elephant-catching operations have taken place a few times since elephants have been preserved, but certainly not more than 100 have been caught, whereas the number of proclaimed rogues that have been shot could not exceed twenty, yet the number of elephants at present in existence seems remarkably small after fifty years of protection, and it would appear that they are not breeding as prolifically as one would have expected under the circumstances. The number of young calves to be seen is extremely small and it has been suggested that this may be due to in-breeding as the result of segregation from the large numbers of elephants in Nepal, of which these United Provinces' elephants originally formed a part. At one time large stretches of the Nepal terai forests adjoined the forests of the United Provinces and there were then numerous opportunities for wild elephants to pass from one country to the other, but much of the Nepal elephant country has since been opened up for cultivation and few elephants now come over from Nepal to inter-breed with the survivors in the United Provinces. The new herd in Pilibhit already referred to has apparently come from Nepal, and it is to be hoped that these animals will spread over the Province and infuse new blood into what seems to be a dying race.

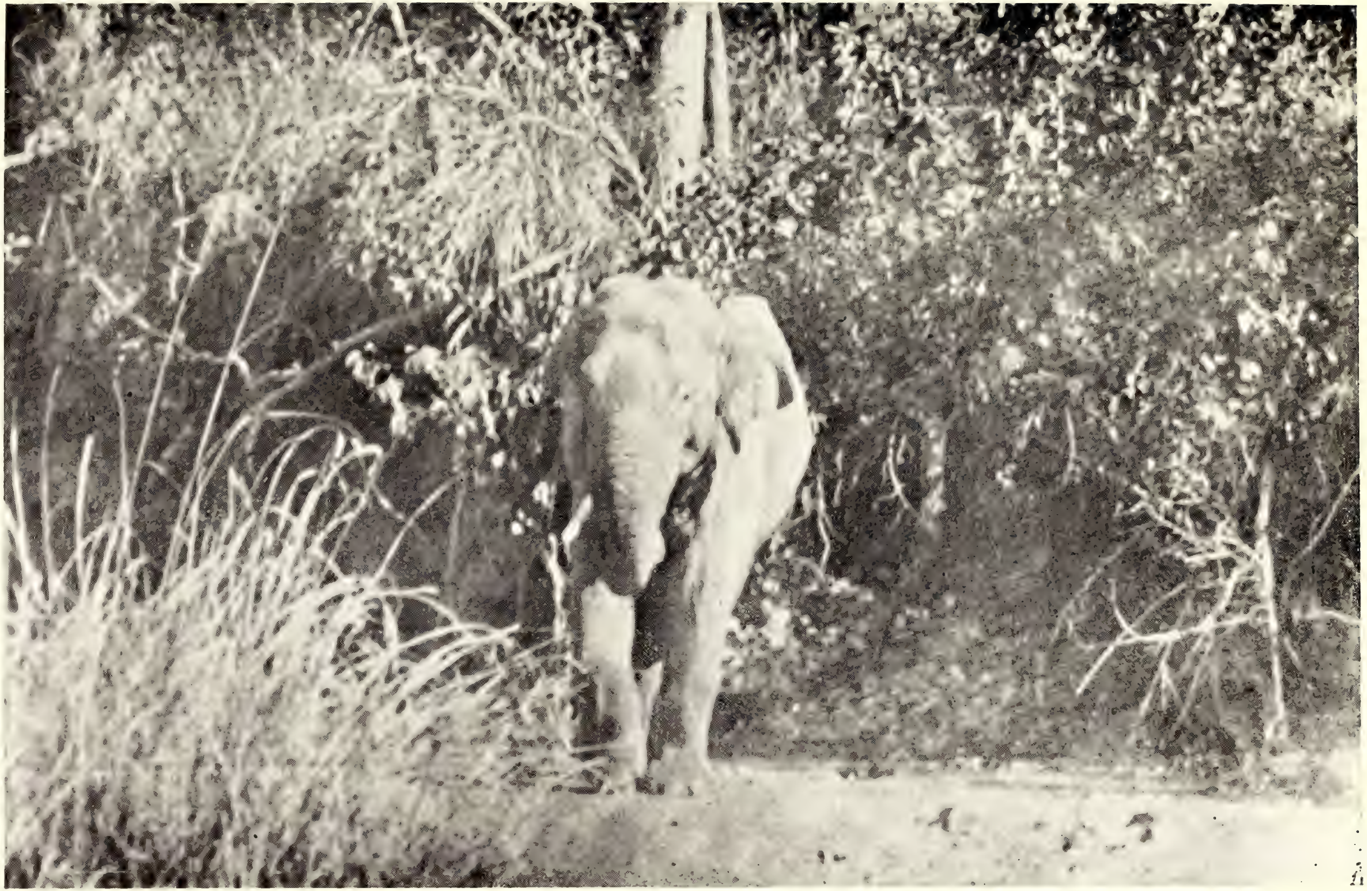
The ordinary wild elephant of the United Provinces appears to be a very inoffensive individual and does not ordinarily do any harm to mankind, although he is held in terrible awe by the local inhabitants and men working in the jungles. Indeed, in Lansdowne Forest Division—the main home of the wild elephants—there has been no casualty from them for the last ten years, although one rogue killed a number of people about the beginning of the Great War, before he was finally shot by the then Divisional Forest Officer, Mr. R. St. G. Burke, within a few hundred yards of the Forest Rest House at Kotwara.

These wild elephants are, however, extremely destructive to bamboo forests and also destroy a considerable number of young sal trees, so that some Forest Officers are of the opinion that they should be caught or destroyed in the interests of Forestry. The Balrampur trackers consider that the number of animals at present in the forests is insufficient to justify the heavy expense of ' khedah ' operations, and it would indeed be a pity if Government were to allow the few remaining wild elephants in Northern India to be slaughtered for the sake of the very slight increase in forest revenue which might result upon their destruction. However, one is glad to be able to write that there is no immediate prospect of such a calamity occurring.

The United Provinces' elephants do not appear to carry very large tusks and I have never seen one with tusks which I should estimate at over 50 lbs. each. There is, however, said to be one famous tusker, known locally as the ' Palak-danta,' which wanders about in the Reserved and Zemindari forests of the Bijnor District, and this animal is reported to be one of the very finest elephants in India, worth a huge sum should it ever be captured. Once or twice agitations have been made by interested people to have this animal proclaimed as a rogue, but fortunately the evidence against him is very weak, and, so far, it has been possible to protect this magnificent creature from an ignominious death at the hands of some local sportsman. I have never had the good fortune to see this beast, or try my camera on him, although I have been in his neighbourhood a number of times and still hope that we may yet meet one day.

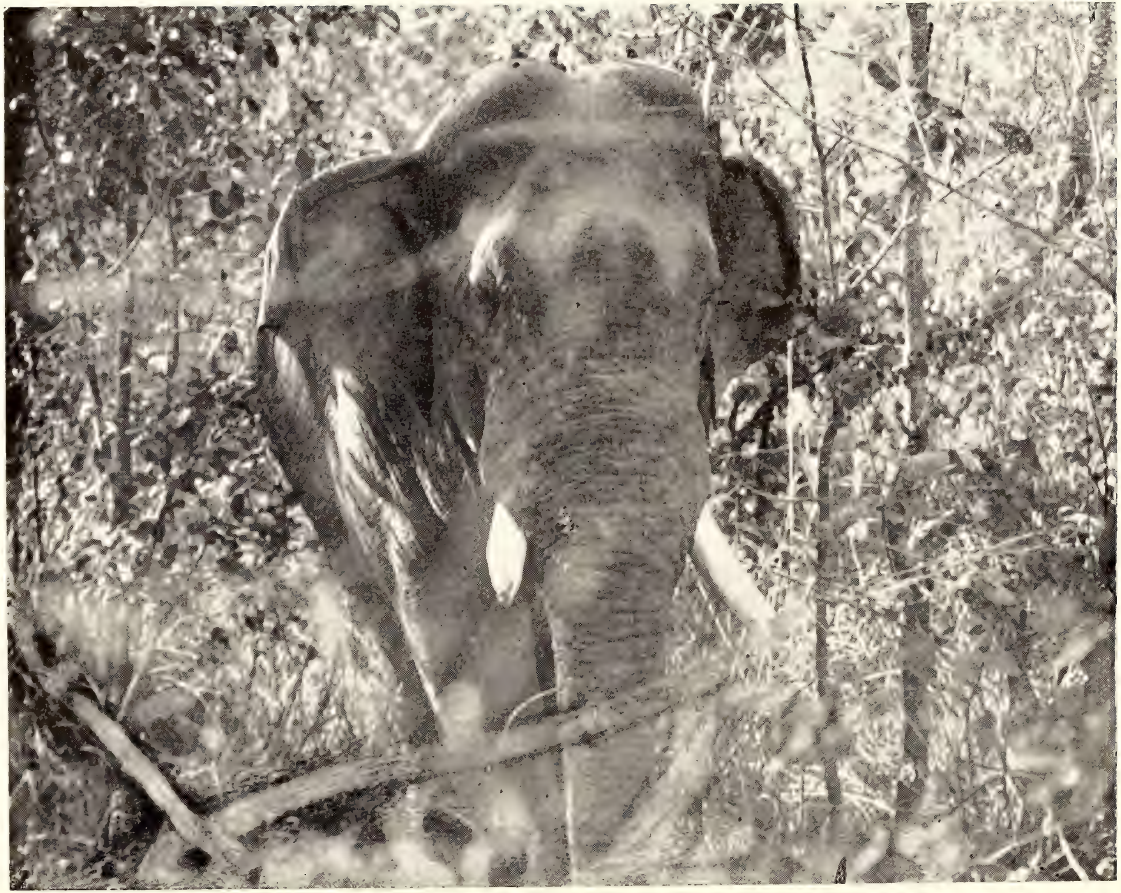
Even though large tusks are rare in the United Provinces, the elephants often grow to a large size and two rogues have been shot within recent years measuring well over ten feet at the shoulder, the details of these two animals being recorded in the current numbers of the *Indian Forester* at the time. Of these, one was shot in the Ramnagar Forest Division in 1914 and measured 10 ft. 4 in. high, the tusks being 6 ft. 4 in. and 6 ft. 3½ in. in length and each 56 lbs. in weight. The other was much the same size and was shot at about the same time in Haldwani Forest Division.

Wild elephants make a most interesting and exciting subject for the animal-photographer and I have managed to make some 50 negatives of individual elephants during the last five years, although I have yet to succeed in making a satisfactory picture of a herd. Some of these pictures have already been reproduced in *Country Life* and elsewhere and some typical examples—which have not yet been published—are included in this article. The first picture



F. W. Champion. Copyright.

A YOUNG TUSKER IN WHICH THE UPPER EAR RIMS HAVE NOT YET BEGUN TO TURN OVER.



F. W. Champion. *Copyright.*

AN OLD TUSKER WITH ONE TUSK BROKEN.

represents a young tusker whose ear fringe has not yet begun to turn over; the second, a middle-aged makna (tuskless male)—a fine muscular elephant; and the third, an old animal in which the ivory was worn and yellow and one of the tusks broken off in the middle. These elephants were all photographed with a reflex camera used from the back of a staunch tame female Forest Department elephant which does not exhibit the fear of wild elephants so common among tame elephants. Indeed, many tame elephants cannot be induced or driven to approach anywhere near one of their wild cousins and the mahawats are often even more afraid. It is somewhat difficult to understand why tame elephants and mahawats should be so afraid of wild elephants, which are normally not dangerous, and which have allowed me to approach within a few yards on numerous occasions without any damage resulting therefrom. True, we were once charged viciously by a 'masth' bull in charge of a herd, and on this occasion we were saved from a bad accident only by firing two barrels of a shot gun over his head, thereby causing him to swerve and rush past us at two or three yards' range; but this was an exception as the 'masth' discharge was clearly visible at some distance, and we were simply asking for trouble by attempting to photograph this particular beast. The usual semi-solitary bull will either bolt the moment one attempts to approach him on a tame elephant, or else he will stand and watch one's approach with deep interest. Indeed, he will sometimes advance towards one as one is taking photographs, and such was the case with the old tusker figured with this article, who approached so close that his whole body could not come within the field of my camera. It is somewhat nervous work taking photographs of a wild elephant—who after all is never fully to be trusted—approaching one in this way; but if one's mahawat fires a shot gun over his head whenever he comes uncomfortably close, in most cases he will retreat, or, at least, not advance any further, so that such photography provides one with a good deal of excitement without being unduly dangerous. I have not attempted to photograph wild elephants on foot, as one's view-point is so low that intervening branches and grass more often than not utterly ruin one's chances, which at all times are none too numerous owing to the bad lighting in the denser forests which the elephants frequent during the daytime. It is, however, perfectly practicable to photograph wild elephants on foot when they are bathing or drinking in open pools, but they seem to prefer the night for such operations and I have never been sufficiently fortunate as to catch one in the act in photographically-possible daylight.

Perhaps the most remarkable feature connected with wild elephants—a feature which has puzzled all who are intimately acquainted with them—is the extraordinary paucity of records of elephants which have been found dead after having died a natural death in the forests. Indeed this subject has been exploited by novelists to a considerable extent in the shape of romances dealing with the hidden stores of ivory which are supposed to exist in Africa and elsewhere as a result of the accumulations of centuries of remains of elephants which have all collected in the same place when they felt death approaching upon them. It is said that expeditions have actually been financed in Africa with the sole object of finding these supposed treasure-troves of ivory, but none has ever been found, and the mystery still remains as to what happens to the bodies of wild elephants when they die. It is to be noted that even Mr. Marius Maxwell, whose recent splendid book *Stalking Big Game with a Camera* is practically a monograph on the African elephant, never found a dead wild elephant during his expeditions, and in his writings seems rather studiously to avoid this subject, which is of such extreme interest to all who are interested in these magnificent creatures.

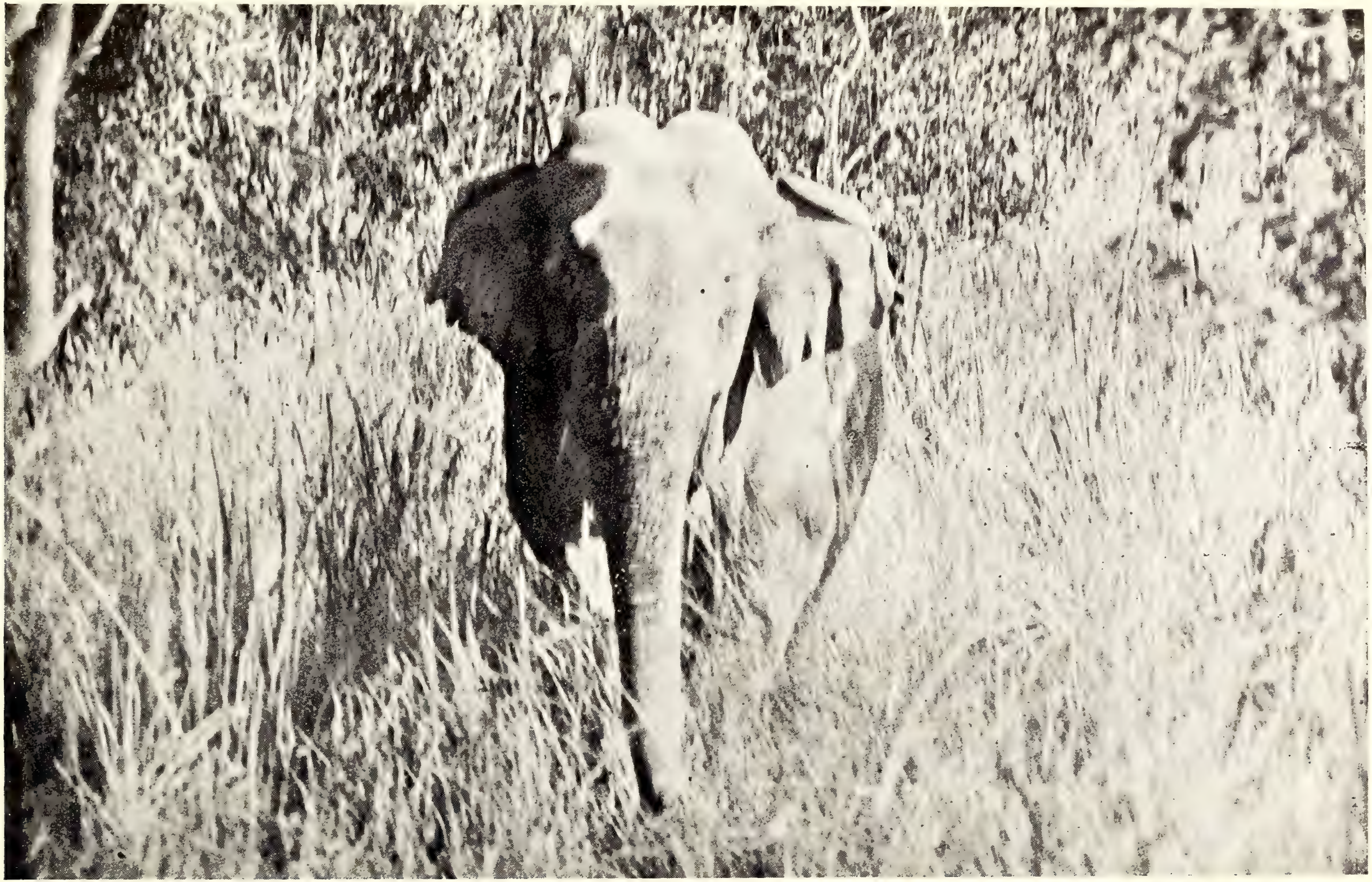
I have therefore attempted to collect all records of wild elephants which have been found dead in the United Provinces forests during recent years and have tried to ascertain the cause of death in each case. The particulars of each record are as follows :—

(1) A dead middle-aged bull elephant with biggish tusks was recorded in 1921 by my brother, Mr. H. G. Champion, I.F.S., from Harai, in Haldwani Division, where it was found on a fireline about two days after death. The distance from water was about half a mile and the cause of death was uncertain, there being no sign of external injury. Some arsenic had been used in the neighbourhood for killing Rohini (*Mallotus philippinensis*) trees, but, as elephants do not eat either the leaves or bark of Rohini, it seemed unlikely that this was the cause of death.

(2) A second dead elephant, a small female, was also found some four days after death at Goria Rau in Haldwani Division the same year. It was not inspected by any officer, but it was said to show a number of wounds on the throat and neck, and may possibly have been killed by a tiger, although such an occurrence is very rare in these forests, however frequent it may be in Burma (*vide* Mr. Hopwood's recent article in the *Indian Forester*).

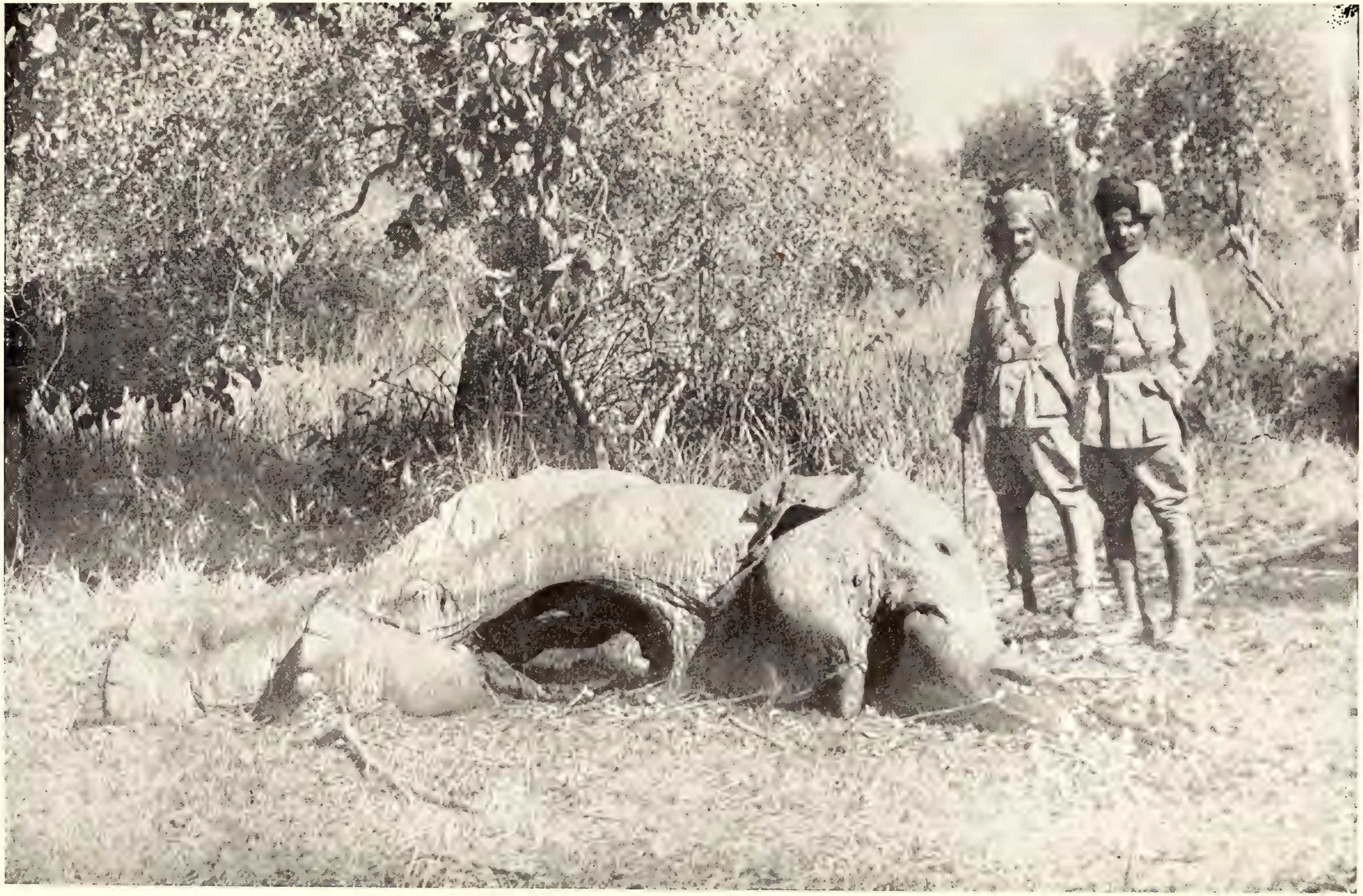
(3) A third case is recorded by Mr. E. A. Smythies, I.F.S., also from Haldwani Division—which, incidentally, appears to be a very fatal place for wild elephants. This animal was a fine solitary tusker with six feet tusks and was found in November 1925 by a marking gang. He had apparently died about the beginning of October in a patch of what would have been swampy ground—but not quicksand—at that time of the year. His legs were embedded in the ground about 2½ to 3 feet deep, and he was half-squatting, half-lying, on his left side. It did not appear that he had been caught in a quicksand—elephants are very clever in avoiding such danger-spots—as there was a solid bank with trees and shrubs about two yards in front of him, and he was not so deeply embedded that he could not have struggled out somehow. He was not an old or feeble elephant, and it is possible that he may have been sick at the time and thus have temporarily lacked the strength to struggle out, or he may have been bitten by a hamadryad.

None of these elephants, however, was a particularly old beast, so that the finding of their carcases does little to help towards a solution of what happens to old elephants when their time comes to depart from this world. The same remark applies to the two dead elephants recorded by Lt.-Col. Faunthorpe in his articles entitled



F. W. Champion. *Copyright.*

A LARGE MIDDLE-AGED MAKNA.



F. W. Champion. Copyright.

A FEMALE ELEPHANT WHICH PRESUMABLY DIED OF OLD AGE.

'The Most Dangerous Sport,' which were published in the *Pioneer* during 1926; but a dead elephant has now been found in this (Lansdowne) Division which appears to be a genuine case of a wild elephant dying of old age. A photograph of the corpse is published with this article, and the case is sufficiently interesting and remarkable to justify my giving a full description of it here.

At the beginning of November, 1926, I received a report from one of my Range Officers to the effect that on October 28, 1926, a female wild elephant had died in the Zemindari Forests of the Bijnor District and that he had gone to see it on October 30, 1926. I instructed him to see that the corpse remained as intact as possible so that I could come to inspect it personally as soon as opportunity offered. This occurred on November 5, 1926, so that I saw the corpse exactly a week after death. It was lying on its side in open grass-forest containing a few scattered trees, and was only about 400 yards from the huts of some graziers, who had brought in the news of its death. Decomposition had already set in and the meat had been attacked by vultures, pigs and hyænas, but, owing to the very thick skin, they had not been able to eat very much of it. I had one shady Ber (*Zizyphus Jujuba*) tree removed and then took the accompanying photograph of it exactly as it was lying. It was a large female in a very emaciated condition, and the general appearance suggested advanced age. There was no hair on the skin, which was very light in colour, and the upper rims of the ears were very markedly turned over, although the lower fringes were not frayed. At the time of death there had not been any diarrhœa, which generally occurs with cattle disease, and there was no blood or any sign of an external wound. The graziers who found the corpse said that they had known this elephant for the last year and that she was so old and weak that she could not run away with the other wild elephants when driven from the crops of the neighbouring villagers. To prove their statement they pointed out the droppings, which contained whole leaves and pieces of grass quite undigested, this being one of the main signs of old age and failing teeth. I then had the jaws cut open with an axe and found that, in the upper jaw, only one molar remained, the grinding surface of which was worn right down to a perfectly smooth surface, whereas the molars in the lower jaw were mere stumps. Under these circumstances it is remarkable that the beast could have managed to remain alive as long as she did, and, to my mind, this appears to be a clear case of a wild elephant dying of old age in open tree forest, which it had frequented for a year or more before death. It is to be noted that, unless death overtook her suddenly, which seems unlikely under the circumstances, no attempt was made to seek seclusion in the very dense and mountainous Reserved Forests which border on the site of death.

A remarkable feature of this case is that the Ranger saw the corpse on October 30, 1926, and noted its position carefully, but when he came with me on November 5, 1926, we found that it had been moved to a different position. A dead elephant weighs something in tons, and the spot is practically uninhabited except for a few graziers, so that I am certain that the corpse was not moved either by man or by scavenging animals such as pigs or hyænas. The graziers state that one or two other wild elephants visited the place while the corpse was lying there and it appears that they almost certainly tried to move her away or to lift her up. Wild elephants are very long-lived animals so perhaps they do not understand what death is and thus attempted to help one of their fellows in distress.

I would suggest that the tradition of wild elephants collecting in some secret place to die has little foundation in fact, and that the hidden treasure-troves of ivory exist only in imagination. Elephants live in very sparsely-populated districts in tropical forests and their life-span is very long. Deaths are therefore not common and may occur anywhere within immense tracts of forest. In tropical countries corpses are attacked by innumerable scavenging creatures such as vultures, crows, hyænas, jackals, pigs and porcupines, whose work is soon supplemented by ants, termites and fungi. Following upon these agents comes the annual monsoon, which produces in a few months, grass and other rank vegetative growth twenty or more feet high, so that a single season may easily remove the entire body and much of the skeleton of an animal even as large as an elephant. The tusks may easily be covered with vegetation and they are certainly largely gnawed by porcupines ; they must also be very old, worn and broken by the time an elephant dies of old age, so that they also might easily disappear after a few year's exposure to a tropical climate and its attendent decomposing influences.

However, records of wild elephants which have died of old age are extremely scanty and one cannot argue from a particular case. Perhaps some of the numerous readers of this Journal can throw more light on this subject ?

SCIENTIFIC RESULTS FROM THE MAMMAL SURVEY
No. XLVII

On the Generic Position of the Afghan Jerboa
(*Alactaga indica*)

BY

Oldfield Thomas, F.R.S.

(*By kind permission of the authorities of the British Museum.*)

In his valuable Summary of the Indian Mammal Survey, Mr. Wroughton placed the Afghan Jerboa, the only Indian member of the family, in Nehring's group *Alactagulus.*[1] But this placing appears to have been done by a misunderstanding of Nehring's paper on the subject, a misunderstanding which I may have been partly responsible for, and in any case it is better to put the proper position on record for the benefit of Indian naturalists.

Nehring formed the subgenus *Alactagulus* to contain *Alactaga acontion*, contrasting the species throughout with *A. elater*, which he rightly took as representing true *Alactaga.* But it is not to *acontion* but to *A. elater* that the Afghan Jerboa is allied, indeed very closely allied, and it is certain that the two are congeneric, while *acontion* is quite a distinct animal, with a different dental formula.

In consequence the proper name of the Afghan Jerboa is, as stated by Blanford, *Alactaga indica*, Gray.

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[1] *Journal, Bombay Nat. His. Soc.*, vol. xxvi, p. 777, 1919.

NOTES ON THE BIRDS OF KASHMIR

BY

B. B. OSMASTON, M.B.O.U.

PART II

(*Continued from page 999 of Volume XXXI*)

(*With a plate*)

122. Motacilla alba personata. The Masked Wagtail.

This is not a common species in Kashmir but it occurs in the valley as also in Ladakh. Females and young of Hodgson's Pied Wagtail (the common Pied Wagtail of Kashmir) are so like this species that they are very apt to be mistaken for it.

A nest of the Masked Wagtail with 4 eggs, was found by a stream at Shusha in Ladakh at 14,000′. It contained 4 eggs which resemble those of Hodgson's Pied Wagtail.

The average of 4 eggs is 20·3 by 14·5.

123. Motacilla alba hodgsoni. Hodgson's Pied Wagtail.

This is the common Pied Wagtail of Kashmir and Ladakh. It is a migratory bird, the great majority leaving Kashmir in the late autumn and returning in March. A few birds may, however, be seen occasionally near Srinagar in winter. They are very numerous throughout the main and side valleys of Kashmir proper frequenting waterways, canals, big and small streams and the margins of lakes and jhils from 5,000′ up to about 10,000′.

In Ladakh they are found on the Indus and its tributaries up to about 12,000′.

They breed in May and June, the nest being placed generally under a stone or dense low bush on a stony island or in part of the dry river or stream bed.

Five, more rarely 6 eggs are laid which resemble those of the English Pied Wagtail.

The average of 10 eggs is 21·9 by 15·6.

124. Motacilla cinerea melanope. The Grey Wagtail.

This is a common species both in Kashmir and Ladakh. They arrive in the valley in March and gradually move up to their breeding grounds up the side streams.

Nidification commences in May at altitudes of from about 8,000′ up to 13,000′ Nests are composed of dry grass and weeds lined with hair, and are placed among stones, under a stone, in a stone wall or in any pile of rubbish generally near a stream.

Five is the ordinary full complement of eggs which are freckled all over with pale yellowish or greyish-brown and which measure (average of 15 eggs) 18·2 by 14·10.

125. Motacilla citreola citreoloides. Hodgson's Yellow-headed Wagtail.

This is an exceedingly common bird in the summer both in Kashmir and in Ladakh. In Kashmir they chiefly breed in the big swamps and jhils, e. g. Hokar Sar at about 5,100′ above in sea-level. Here they are very numerous. The nests are placed on the ground in tufts of grass, a few inches above the swamp level and are well concealed. They were also found breeding at about 11,500′ in an extensive patch of swampy ground near the Gangabal Lake (Haramukh.)

On crossing the Himalayan Range into Ladakh they are found again breeding in large numbers in the Dras and Suru Valleys at from 10,000′ to 12,000′ as well as in the Indus Valley and around Shushal, etc., at 14,000′. Also at Puga in Rupshu, at 14,000′.

The breeding season is May and June in the Valley of Kashmir, June, July and August of Ladakh.

Cock birds are very striking and handsome with their lemon-yellow heads and breasts and black backs. The hen birds are found in two distinct phases of plumage.

PATH NEAR SONMARG.

A CORNER OF WULAR LAKE.

(1) Young birds, presumably one year old, where the yellow of the male bird is replaced by very pale yellow, almost white.

(2) Birds of two years and over much yellower than (1) but paler yellow than the males.

Both these varieties are found breeding. Nests are well concealed on the ground among grass, rushes, etc., often on the 'bunds' alongside irrigation channels between cultivated fields.

Four is the ordinary full clutch of eggs but 5, 3 and 2 incubated eggs are found.

They are of a mottled pale khaki or yellow-brown with often a black streak at the broad end. Eggs from Ladakh average larger than those from the Valley of Kashmir as will be seen from the following comparative figures :—

Ladakh	*Hokra*
Average 80 eggs.	Average 60 eggs.
20·9.×15·1.	20·1×14·5.
L. ... *22·4* × 15·0	B. ... 20·6 × *15 9.*
S. ... *17·6* × 14·1	N. ... 20·4 × *14·0.*

126. Anthus trivialis haringtoni. Witherby's Tree Pipit.

Not uncommon in the summer just above the tree limit at from 11,000′ to 12,000′ on the Kashmir side of the Himalayan Range.

A nest found on the open mountain side above Zogpal in the Lidar Valley at about 11,500′ was made of grass and lined with finer grass. It contained three fresh eggs on July 12, the average measurement of which is 19·3 by 15·2.

127. Anthus similis jerdoni. The Brown Rock Pipit.

This is a common bird in the summer months on the lower, base, rocky and stony slopes of the hills bordering the Kashmir Valley from 5,000′ to 6,000′.

They frequent rocky slopes devoid of shrubs as well as those upon which there is a certain amount of low scrub, but they never enter the forest.

They are early breeders, nests with eggs being found from April throughout May and June. Nests are composed of dry grass, lined with the same and are placed on a steepish slope under a tuft of grass or at the base of a low bush. Three or four eggs are laid which are white rather heavily marked with spots and blotches of brown, greyish-brown or reddish-brown—which measure as follows :—

L. ... *23·9* × 16·1 B. ... 23·7 × *17·6* } Average (24 eggs), 23·0 by 16·6.
S ... *21·8* × 16·5 N. ... 23·6 × *16·0* }

The bird has no song, only a single note, uttered at short intervals, sometimes higher and sometimes lower in tone.

128. Anthus roseatus. Hodgson's Pipit.

This is a fairly common bird in Kashmir. In winter they are to be found in damp ground in the Valley of Kashmir and in summer on the open grassy slopes on the Himalayas and Pir Panjal Range at from 10,000′ to 13,000′ above the tree limit, and here they breed in June. A nest found above Liddarwat in the Lidar valley at 10,500′ was placed under a small tuft of grass on a steep grassy slope. It was composed of dry grass, lined with the same material, and contained 4 fresh eggs very handsomely marked with dark purplish-brown.

They measure (average) 21·8 by 16·0.

129. Otocorys alpestris longirostris. The Long-billed Horned Lark.

This large, handsome lark is common in summer at high altitudes on both sides of the Himalayan Range but especially so on the Ladakh side, and less common on the Pir Panjal Range. They occur chiefly between 11,500′ and 13,500′, on open dry sandy hillsides with scattered tufts of grass and herbacious plants, especially where there is much artemisia.

The male bird has a short rather loud and sweet song of a few notes uttered from a fixed perch generally from the top of a rock. These birds do not ever soar in the air like the skylark.

Nests are placed in a small depression in the ground scraped out by the parent bird, which is placed under the shelter of a tiny *Artemisia* or other small herbacious plant. The nest is composed of a few bits from of dry neatly lined with very fine cottony down from the *Artemisia* plant.

Three or 2 eggs only are laid, which resemble generally those of the skylark but are larger. They measure :—

L. ...	*27·5* × 17·6	B. ...	27·5 × *17·6*	Average (11 eggs), 24·5 × 17·4.
S. ...	*23·0* × 16·9	N. ...	23·0 × *16·9*	

130. Otocorys alpestris elwesi. Elwes' Horned Lark.

This species is common throughout Ladakh at high elevations, from 13,000′ to 17,000′, except in Western Ladakh, on the slopes of the Himalayas, where it is replaced by the preceding species. They prefer stony, sandy ground, especially where there is a sprinkling of weeds or grass, and they are specially fond of localities where *Artemisia* is found.

The male has a short, rather shrill, song of a few notes, uttered from the top of a rock or stone, which somewhat resembles the song of the corn-bunting.

Nidification commences early in June, and 2 more rarely 3 and sometimes only one, eggs are laid. Nests are placed in small circular depressions scratched in the ground, often in the shelter of a small plant or stone and are lined with soft vegetable down.

The eggs are more or less densely mottled all over with yellowish or greyish-brown with a darker cap or zone at the broad end.

Eggs give the following measurements :—

L., from 26·1 to 21·6. B., from 17·4 to 16·2. Average (24 eggs), 24·4 by 16·9.

131. Alauda gulgula guttata. The Small Kashmir Skylark.

This is a very common bird in Ladakh in the Indus and Nubra Valleys as well as in the Dras and Suru Valleys. They arrive in Ladakh in the end of April and are found wherever there is permanent cultivation between 10,000′ and 12,000′. They frequent the barley, lucerne and grass meadows. The song of the male resembles that of the English skylark and it is uttered while soaring, as well as from a fixed perch on a bush or rock. They may often be heard singing before sunrise, but chiefly a little later in the day. Breeding commences in the end of May and fresh eggs are obtainable throughout June and July.

Nests are placed on the ground in a slight depression among grass, lucerne or young barley. Four is the usual full complement of eggs laid, but sometimes 3 only, and more rarely 5 are found.

Eggs resemble those of the English skylark in colour. They measure :—

L. ...	*25·6* × 17·1	B. ...	25·6 × *17·1*	Average (41 eggs), 23·1 by 16·3.
S. ...	*21·1* × 15·5	N. ...	22·1 × *15·3*	

A very similar skylark, which appears to be the same sub-species, is found breeding in the Kashmir Valley at 5,200′.

The eggs of this bird are similar, but smaller on the average as is shown by the following measurements :—

L. ...	*24·4* × 16·4	B. ...	20·9 × *17·1*	Average (15 eggs), 21·5 by 16·5.
S. ...	*20·2* × 17·1	N. ...	21·1 × *15·7*	

132. Calandrella acutirostris tibetana. Brook's Short-toed Lark.

This is an exceedingly common bird throughout Ladakh being found almost everywhere from 10,500′ to 16,000′, except on steep ground. They are also found in the Dras and Suru Valleys, where however they are not so common. They affect sandy plains and gentle hill slopes dotted with stones and small rocks and with here and there scanty herbacious vegetation. The song, emitted from the top of a rock or stone, is poor and monotonous.

The nesting season commences in the end of May and fresh eggs may be found throughout June and the first half of July. Nests occupy slight depressions in the ground scantily lined with a little dry grass and finished with a dense, warm lining of very fine vegetable down. They are placed in the shelter of a stone or small plant, more rarely quite exposed.

Three eggs is the full clutch, but not infrequently 2 only are laid. They are rather elongate ovals, spotted all over with pale greyish or yellowish brown, occasionally in a zone at the broad end.

They measure :—

L. ...	*23·0* × 14·0	B. ...	22·0 × *15·6*	Average (49 eggs), 21·0 by 14·6.
S. ...	*19·4* × 15·1	N. ...	23·0 × *14·0*	

133. Zosterops palpebrosa elwesi. The Western White-eye.

This is not a very common bird in Kashmir, but it is found occasionally in the valley and on the lower wooded slopes of the hills up to about 6,000′, where it breeds. It is also occasionally seen in the spring and autumn in Srinagar. It is probably common on the lower south-west slopes of the Pir Panjal, in Jummoo and Punch.

134. Picus squamatus squamatus. The Scaly-bellied Green Woodpecker.

Occurs in Kashmir, in wooded areas up to about 8,000′ altitude, but is not very common. In winter they descend to the lower hills and valleys and may sometimes be seen in and near Srinagar.

135. Dryobates himalayensis. The Western Himalayan Pied Woodpecker.

Common in well-wooded areas on the slopes of the main and side valleys and hills generally up to about 9,000′. They are found both in fir and in mixed forest. They are early breeders.

Two nests, each containing 4 fresh eggs, were found in the Sind Valley in the third week of April in holes in willow trees about 12 from the ground. Eggs glossy, and of course pure white. They measure :—

L. and B. ... 28·0 × 19·9 } Average of 8 eggs, 26·5 by 19·1.
S. and N. ... 24·5 × 18·1 }

136. Dryobates auriceps. The Brown-fronted Pied Woodpecker.

Occurs on the lower wooded slopes in the main valley, but is not common.

137. Iynx torquilla japonica. The Kashmir Wryneck.

This is a common bird in Kashmir in the summer, especially in and around Srinagar. They are most numerous in the willow copses in the main valley, but they ascend the valleys and hills up to 11,000′. A bird was heard calling at Kargil 9,000′, but they are very rare in Ladakh.

They arrive in the last week of March and are very noisy, calling throughout April and May. Their call is identical with that of the European Wryneck.

Breeding commences in the middle of May, eggs being laid in holes in trees, chiefly in rotten portions of willow trees, excavated by the parent birds. The eggs are laid on the bare wood, or on a layer of fine chips.

Two nests found on May 23 and 24, contained 6 and 7 nearly fresh eggs respectively, pure white with slight gloss.

They measure :—

L. ... *22·1* × 14·9 B. ... 21·0 × *16·1* } Average of 13 eggs,
S. ... *20·7* × 15·9 N. ... 20·6 × *14·9* } 21·1 by 15·5.

138. Coracias garulla semenowi. The Kashmir Roller.

A fairly common bird in the valley of Kashmir and in the side valleys up to about 6,500′. They arrive in the spring and leave again, in the autumn, generally in October. In their habits they resemble the Indian roller and are often to be seen perched on the telegraph wires or on the dead branch of a tree from which they have a commanding and uniterrupted view of their surroundings.

Breeding commences in June, a hole in a steep bank, often the river bank, or in a hollow tree being selected as a nesting site.

Five or 6 eggs are laid, pure white and rather elongate ovals, with considerable gloss. The eggs are not infrequently speckled all over with small dark brown spots, which are readily removed by washing. The origin of these spots is not known but exactly similar spotting has been observed in the case of the eggs of *Ceryle rudis* and *Melittophagus erythrocephalus* in other parts of India.

Eggs' measurements are as follows :—

L. ... *39·1* × 27·6 B. ... 36·1 × *29·9* } Average (16 eggs),, 36·3
S. ... *34·2* × 29·4 N. ... 36·7 × *27·4* } by 29·0.

139. Merops apiaster. The European Bee-eater.

This is a common bird in the main valley of Kashmir and for a short distance only up the larger side valleys during the summer months. They arrive in the end of April or early in May and leave in the end of August or early in

September. They frequent the foothills and the lower slopes of the Takht-i-Suleiman, especially wherever there are soft alluvial banks or cliff. Breeding commences early in June and the birds usually nest in small scattered communities. For the reception of the eggs a hole about 2 inches in diameter is excavated in moderately soft alluvium or clay-loam. The hole slopes gently upwards for a distance of about 3 ft. at the end of which there is a spacious egg-chamber 9 inches or so in diameter, which is unlined.

Five or six rather spherical, glossy, white eggs are laid which measure as follows :—

L. ... *28·1* × 21·1 B. ... 26·9 × *22·2* } Average, (23 eggs) 25·8 by
S. ... *25·2* × 21·1 N. ... 28·1 × *21·1* } 21·9.

140. Ceryle rudis leucomelanura. The Indian Pied Kingfisher.

A fairly common bird in the main valley of Kashmir, along streams and the borders of lakes, e.g. the Wular, Dal and Anchar Lakes. This is a resident species, and an early breeder, fresh eggs having been observed on March 1, while snow was still lying about.

Nest holes are excavated in steep banks often but not always near streams. The hole is about 3′ long and the nest cavity contains as a rule a layer of fine fish bones, doubtless thrown up in ‘ castings ’ by the parent birds.

Five or 6 eggs are laid, not very spherical, nor very glossy. They are, of-course, pure white and measure :—

L. .. *32·8* × 22·9 N. ... 30·8 × *22·4* } Average (15 eggs),
S. and B.... *28·2* × *22·45* } 3·03 by 23·6.

141. Ceryle lugubris guttulata. The Himalayan Pied Kingfisher.

This is rather a rare bird in Kashmir, being only occasionally met with along the larger rivers and side streams, up to about 6,000′ altitude.

This handsome bird, the largest of all the Indian Kingfishers, would undoubtedly be commoner in Kashmir if it were not for the ruthless persecution they are subjected to in the interests of fish preservation.

They are early breeders, nesting in holes excavated in the banks of streams and rivers. Unlike the preceding species they never hover in the air but dive after fish from a fixed perch.

142. Alcedo atthis pallasii. The Central Asian Kingfisher.

This is an extremely common bird throughout the Valley of Kashmir being found along every river, stream and water course as well as along the borders of the lakes and in the larger jhils. They are resident birds but they do not appear to be so numerous in the winter, so possibly some birds move down to more congenial altitudes in the frosty weather. They are found up the side valleys to about 7,000′ elevations, rarely higher but a single bird was seen near Dras (Ladakh) on May 2, at 10,500′ and a second bird above Leh at 12,000′ towards the end of May. With these exceptions the species was not met with in Ladakh.

Breeding in Kashmir commences in April and fresh eggs may be found till the end of May. From 5 to 7 glossy, rather spherical, pure white eggs are laid measuring :—

L. ... *22·1* × 17·9 B. ... 20·2 × *18·2* } Average (37 eggs), 21·2 by
S. ... *20·2* × 18·2 N. .. 20·7 × *17·0* } 17·6.

Nest holes are excavated in clay or alluvial banks, sometimes close to water, but not infrequently at a considerable distance away, nests having been observed on the slopes of the Takht-i-Suleiman, at least a quarter of a mile from the Dal Lake 200′ to 300′ above the level of the same. This beautiful little Kingfisher is very tame and confiding in Kashmir, perching on the house boats and other river craft in complete disregard of its human occupants, and it would be a good deal commoner than it is were it not that large numbers are destroyed annually by the staff of the Fishery Department.

Such slaughter is to be deprecated, in that it is improbable that this Kingfisher, even if unchecked, would perceptibly affect the stock of trout, and the bird is undoubtedly a great asset to scenery of lake and stream in Kashmir, and one probably more generally appreciated than the fish.

143. Upupa epops epops. The European Hoopoe.

This is a very common bird in the Valley of Kashmir, especially in and around Srinagar. It is also found up the larger side valleys, where it may be seen occasionally as high as 9,000′ or even higher. It is also found, though much less common, in Ladakh, especially near irrigated land and about villages and in Leh, up to about 12,000′. It is probably commoner in Kashmir than anywhere, certainly than anywhere in the east, an abundance of food being everywhere and always available in the ever-moist grassy meadows and gardens.

They feed largely in Kashmir on the grubs of Cockchafers which they dig up in the grass lands, but they are often robbed of their prey as soon as they have obtained it, by the cheeky and ubiquitous Sparrow.

The majority arrive in March and leave in September, but a few birds may be seen occasionally even in winter. Breeding commences in April, 6 or 7 eggs being laid on the ground with no nest, sometimes in a hole in a mud wall, often in a stone wall, and less frequently in a hole in a hollow tree.

More than once eggs have been found laid on the floor of a large dark ' godown ' to which the bird has found access through some small hole.

The eggs are pale skim-milk blue when quite fresh, but they become rapidly discoloured even after 24 hours, and they are then a dull pale dirty greenish-grey.

They measure :—

L. ... *27·2* × 17·5 B. ... 25·5 × *18·6* } Average (26 eggs), 26·2 by
S. ... *24·6* × 16·7 N. ... 25·4 × *16·7* } 17·6.

144. Micropus melba melba. The Alpine Swift.

Not common, but occasionally seen at high elevations in flight.

145. Micropus apus pekinensis. The Eastern Swift.

Not uncommon between 9,000′ and 12,000′, both in Kashmir and in Ladakh, breeding in precipitous rocky ground.

Many were observed in the last week in May in the Indus Valley near Leh at 10,500′, hawking flies. They had probably only just arrived. Later they were noticed in the Shyok Valley at 10,500′ in July and below Khardong, near Kharchar, they were breeding in cliffs at 11,000′. They also breed in the crags above Sonamarg (10,000′) and near, Tosha Mundan (in the Pir Panjal) at 10,500′.

146. Micropus pacificus leuconyx. Blyth's White-rumped Swift.

Occasionally seen on the wing at higher elevations on the great Himalayan Range.

147. Micropus affinis galilegensis. The Kashmir House-Swift.

Fairly common in and around Srinagar.

148. Cuculus canorus telephonus. The Asiatic Cuckoo.

This is by far the commonest cuckoo found in Kashmir. They arrive towards the middle of April and leave during September. They are found throughout the summer, in fairly large numbers, on the Pir Panjal, as well as on the Himalayan range, alike in the valleys and on the higher hills. They breed during May, June and July from about 6,000′ up to 13,000′.

At the lower elevations they chiefly parasitize the Indian Bush-Chat (*Saxicola torquata indica*) and at higher levels, the Himalayan Ruby-throat (*Calliope pectoralis pectoralis*) the Redstarts (both *Phœnicurus frontalis* and *Phœnicurus ochrurus phœnicuroides*) and Hodgson's Pipit (*Anthus roseatus*). In Ladakh they are very scarce except in the western portion i.e., in the Dras and Suru Valleys and slopes of the great Himalayan divide, where they are common from 10,000′ to 13,000′. Their call which exactly resembles that of the European cuckoo, is heard throughout May and June and even as late as July 24.

An egg obtained on ? July, in the Lidar Valley at 7,000′ elevation in the nest of the Indian Bush Chat was white with rusty spots. It measured 24·0 × 17·4.

A second egg, from the nest of *Calliope pectoralis* was found on July 26, at the head of the Wardwan Valley below the Bhotkhol Glacier at 11.000′. It was of a uniform blue, and measured 25·4 by 19·5.

149. Cuculus optatus. The Himalayan Cuckoo.

This cuckoo, so common in Garhwal and Kumaon is relatively scarce in Kashmir. Its characteristic note—Hoo-Hoo-Hoo-Hoo—resembling somewhat the call of the Hoopoe—was heard occasionally below Gulmarg and in the Lidar Valley in June, at about 8,000′.

150. Cuculus poliocephalus poliocephalus. The Small Cuckoo.

This species is decidedly commoner than the last being found from about 8,000′ up to 12,000′, on all the higher ranges including the Pir Panjal, but chiefly at about 10,000′ to 11,000′.

The call of this Cuckoo is peculiar and unmistakeable. It consists of a rather unmusical cackling call of from 4 to 6 notes, first 4, then 5 and then 6 the call of 6 notes being repeated several times in a gradually descending scales I agree with Colonel MacGrath that the call of the bird resembles the syllables 'That's your smoky pepper.'

This cuckoo lays two distinct kinds of eggs, viz. (*a*) pure white and (*b*) uniform chocolate pink one would expect to find the latter type of egg laid in the nest of *Horornis*, but although I have found many nests of this bird in Kashmir in localities where this cuckoo was in evidence I was never fortunate enough to discover its egg.

In the Darjiling District several eggs the chocolate pink type were found in nests of the Short-wing (*Heteroxenicus*) and again in Garhwal in the nest of *Pnœpyga squamata* ; in both cases in company with *white* eggs.

151. Clamator jacobinus. The Pied Crested Cuckoo.

I was surprised to find this species, so characteristic of the plains of India, as a summer visitor to the Valley of Kashmir. They are local and not common. I found them frequenting the lower bush-covered slopes of the hills near Srinagar between 5,000′ and 6,500′.

In the plains of India they parasitize chiefly the common Babbler, *Argya caudata*, but this bird is not found in the Valley of Kashmir.

It is most probable that in Kashmir this cuckoo lays in the nest of the Streaked Laughing-thrush (*Trochalopterum lineatum*) which is common in the jungle frequented by this cuckoo.

152. Penthoceryx sonneratii sonneratii. The Bay Banded Cuckoo.

I never personally met with this bird in Kashmir but Mr. S. L. Whymper obtained one in the Lidar Valley in July 1905.

It must, I think, be a rare bird in Kashmir.

153. Psittacula schisticeps schisticeps. The Slaty-headed Paroquet.

Fairly common in the lower mixed forests of the main and side Valleys up to about 6,500′, and occasionally higher.

154. Tyto alba javanica. The Indian Barn Owl.

Not uncommon in the vicinity of Srinagar where it may be heard calling a night.

155. Strix aluco biddulphi. Scully's Wood Owl.

This Owl is common in Kashmir in all wooded areas from the level of the main valley (5,100′) up to the tree limit at 11,000′. It also occurs in Srinagar and a specimen was obtained in the winter in Peshawar.

They are nocturnal in their habits, and, when discovered, are mobbed in the day time by crows and other small birds. One was seen near Srinagar being chased and eventually killed, by a pair of Hawk Eagles. The ordinary call of this Owl is a loud Hoo.........Hoo......Hoo-oo-oo-oo. With an interval of some four seconds between the first and the second Hoo, and about half a second between the second Hoo and the final rolling note a loud 'Quack' is also sometimes heard as well as a soft 'coo' very similar to the call of the Ring Dove.

156. Bubo bubo bengalensis. The Rock Horned Owl.

Fairly common on the lower rocky hillsides on all sides of the main Kashmir Valley between 5,000′ and 6,000′. A couple of pairs are resident on the

Takht-i-Suleiman near Srinagar. These birds are not very nocturnal and they may often be seen in the mornings or evenings perched on a rock on precipitous hillside, but they avoid direct sunlight.

They feed almost entirely on rats, with an occasional Musk Shrew, as may by seen from their castings. The call, heard in the dusk before dawn or after sunset, is a loud *Hoo* (a single, not a double note.)

Nidification commences in March, three eggs being laid in sheltered holes or small caves among rocks on steep, almost percipitous, rocky hillsides. On one occasion a jungle crow was observed in close proximity to a nest containing three fresh eggs. On being scared away it was found that he had just broken into one of the three eggs, all of which would doubtless have been sucked in due course.

The eggs are large broad ovals without gloss measuring :—

L. and B. ... 61·3 × 47·7 } Average (6 eggs), 60·1 by 47·3.
S. and N. ... 58·7 × 46·4 }

157. Bubo bubo. (? subsp.)

A large Horned Owl was observed on three occasions in Ladakh.

(1) In the ruins of the Lamasery at Basgu (Indus Valley) at 10,000′.
(2) On the rocks above Puga (Rupshu) at 14,000′.
(3) On the Lamasery Hill at Nimu Mud (Indus Valley) at 13,500′

They undoubtedly breed in all these three localities.

158. Glaucidium cuculoides cuculoides. The Large Barred Owlet.

A pair were seen in the olive grove near Garhi (elevation 3,000′) on the Jhelum Valley road.

159. Glaucidium brodiei. The Collared Pigmy Owlet.

This Owlet, so common in the upper hill forests in Garhwal and Kumaon, from 8,000′-9,000′ is decidedly rare in the Kashmir. It was heard calling on 2 or 3 occasions only below Gulmarg on the Pir Panjal Range. The call is a clear bell-like whistle repeated four times, with a short pause between the first and second and again between the third and fourth notes thus :

Hoo—Hoo-Hoo-Hoo.

160. Pandion haliaëtus haliaëtus. The Osprey.

Not infrequently seen on the Wular Lake and along the Jhelum River as far up as Srinagar. They are chiefly seen in the cold weather months but a pair were seen as late as April 24, and the birds are reported to have bred in the neighbourhood of the Lake.

161. Ægypius monachus. The Cinereous Vulture.

This bird is rarely seen in Kashmir.

162. Gyps himalayensis. The Himalayan Griffon.

Common in Kashmir from the level of the valley up to at least 12,000′.

As many as fifty were counted round the carcase of a buffalo at 10,000′ in the Lidar Valley. They are much less common in Ladakh but a few were seen in May near Dras. They breed on rocky precipices from 6,000′ to 8,000′ nests being usually inaccessible without ropes.

Two nests were obtained on February 11 and 15, at 6,500′ while snow was still on the ground. They contained one fresh egg each, spotless white, which measure 96·0 × 69·0 and 88·4 × 69·7 respectively.

163. Neophron percnopterus percnopterus. The Egyptian Vulture.

Not common in Kashmir, but is found generally distributed in the valley. Two pairs breed on preciptous ground on the Takht, Srinagar, at 5,500′.

These birds appear to be summer visitors only, presumably retiring to the plains in winter.

Two eggs are laid in a nest composed of sticks and lined with dead leaves, rags, paper, etc. They are white richly marked with deep reddish brown They measure (average of 6 eggs) 66·4 by 51·8.

Fresh eggs are obtainable about the middle of April.

164. Gypaëtus barbatus grandis. The Eastern Bearded Vulture.

This great bird is found commonly in Kashmir on all the hills surrounding the valley from about 6,000′ upto 13,000′ and also in Ladakh, where however it is rare. They are usually to be seen quartering the open hillside on motionless wings, only rarely having recourse to a few measured wing-flaps.

They may frequently be observed to rise upwards of a thousand feet in a few minutes in big circles, without a single stroke of the wing evidently taking advantage of rising currents of air.

They feed on carrion, including bones, and have never been observed by the writer attacking or threatening a living animal.

165. Aquila nipalensis nipalensis. The Eastern Steppe Eagle.

Occasionally seen in the vicinity of Srinagar and elsewhere in the Valley in the winter months.

166. Hieraëtus fasciatus. Bonelli's Eagle.

Not common but occasionally seen singly or in pairs in the main and side Valleys of Kashmir below 7,000′.

167. Hieraëtus pennatus. The Booted Eagle.

Not uncommon in the Valley of Kashmir where they breed in May. At least two pairs breed near the tops of very big chenar trees in Srinagar and they are responsible for most of the thefts of domestic fowls, attributed to the black-eared kite.

A single egg, obtained on May 15, was pure white, fresh, and measured 51·7 by 41·9.

168. Cuncuma leucorypha. Pallas' Fishing Eagle.

A fairly common bird in the vicinity of lakes and jhils in the main valley of Kashmir, where they are resident, nesting in early spring or late winter on the summits of huge chenar trees.

They also occur in Ladakh, a pair having been seen at 10,600′ in the Indus Valley and another pair near the Tso Moriri Lake at 15,000′ in Rupshu. This was in June. Col. Meinertzhagen informs me that he found a pair ensconced near the jhil at Shushal (14,200′) which had killed off practically all the young geese (*Anser indicus*) on the water.

169. Milvus migrans lineatus. The Black-eared Kite.

This is the common kite of Kashmir. It is found throughout the main valley, and is specially numerous in and around Srinagar. They are also seen on the surrounding mountains up to at least 11,000′, but they probably all breed in the valley between 5,000′ and 6,000′.

A few were seen also in Ladakh, especially near Leh, where they also breed.

This kite is resident in Kashmir throughout the year. Breeding commences about the middle of March. Nests are usually placed high up in a fork of a big chenar tree, from 50′ to 100′ from the ground and are generally difficult to reach. They are occasionally also built in poplars and large mulberry trees and are there more easily accessible.

The nest is a large mass of sticks, lined with wool, hair, rags, paper, etc. Two eggs—more rarely 3—are laid which resemble those of the common pariah kite, but are larger on the average. The ground colour is white, and the eggs are blotched, spotted or sometimes lined in various degrees, with chestnut brown.

They measure :—

L. *61·8* × 42·4 B. 59·7 × *47·4* }
S. and N. *53·4* × *41·7* } Average of 59 eggs, 57·9 by 45·3.

The average of 47 eggs of *M. migrans govinda* taken in Rawalpindi is 52·4 by 43·0.

170. Circus macrourus. The Pale Harrier.

171. Circus cyaneus. The Hen Harrier.

Both the above species may often be seen during the autumn winter and early spring months quartering the ground in the valley.

172. Circus æruginosus æruginosus. The Marsh Harrier.

This is a common bird in all the jhils and marshes in the Valley of Kashmir. They arrive as a rule early in September and leave again in April or May, but occasionally a bird may be seen in summer and it is probable that rarely a few stop and breed in the valley.

173. Buteo ferox. The Long-legged Buzzard.

This bird is not rare at high elevations on the Himalayan and Pir Panjal Ranges, on both sides of the valley. They are usually found near the upper limit of the forest or well above it up to about 13,000′.

They usually place their nests in precipitous rocky ground.

They feed to a large extent on small voles. The cry is a loud ' mewing ' call.

174. Accipiter nisus melanochistus. The Indian Sparrow Hawk.

This hawk is not uncommon in Kashmir at all elevations up to about 11,000′. A pair was also observed at Khalatze on the Indus, at 9,500′ in Ladakh. They breed in Kashmir.

175. Falco peregrinus calidus. The Siberian Peregrine.

Occasionally seen in Kashmir in the cold weather. A single bird was seen in the Indus Valley, Ladakh at 13,500′. It had captured a chough. This was early in July.

176. Falco subbuteo subbuteo. The European Hobby.

With the exception of the Kestrel this is the commonest falcon occurring in Kashmir. It is found in the main valley as well as on the hills and mountains, and on rocky mountain sides as well as in rather open forest. It is also found in Ladakh where it is not rare.

July is the month when nidification takes place. The nest is placed fairly high up in a tree. A nest found in the Indus Valley at 10,500′ above Chushot was in a poplar grove. The nest was incomplete in June. A second nest at Kargil 9,000′ in Ladakh was also in a poplar tree, in the nest of a carrion crow from which I had previously (in May) removed the eggs. On August 4, it contained three young in down. A third nest was half-way up a spruce fir standing on an island in the Lidar River near Pahlgam at 7,000′. It contained 3 fresh eggs on August which resemble kestrel eggs in colour. A fourth nest was at the top of a silver fir in Gulmarg, in July. The average measurement of 3 eggs is 39·5 by 31·5.

177. Falco tinnunculus. The Kestrel.

A kestrel, possibly the Indian Kestrel, is common throughout Kashmir at all elevations from 3,000′ up to at least 14,000′.

They breed on rocky cliffs.

A kestrel, possibly the same species, is found throughout Ladakh up to 16,000′. They are common in Leh where they build in poplar trees. Two nests taken in the first week of June contained 4 fresh eggs in each, rather paler in marking than those of the European kestrel.

They vary in length from 41·2 to 38·7 and in breadth from 33·8 to 30. The average of 7 eggs being 40·0 by 32·3.

178. Columba livia intermedia. The Indian Blue Rock Pigeon.

Common in the Kashmir Valley, as well as in the lower and upper hills, up to about 9,000′. They are chiefly found on the lower rocky hills, where they breed from May to August. Their eggs average about 39·8 by 28·0.

179. Columba livia neglecta. Hume's Blue Rock Pigeon.

Common in Ladakh, in the Indus, Shyok and their side valleys up to about 11,000′ They are chiefly to be seen in and around cultivation, where they often associate in large flocks, mixed with the blue hill pigeon and occasionally also with the snow pigeon.

They breed in rocks and ruined buildings. A nest in the Basgu ruined Fort in the Indus Valley at 10,500′. Contained a single fresh egg on May 11 and another single egg in the same nest on July 23.

These eggs averaged 40·6 by 28·5.

180. Columba rupestris turkestanica. The Indian Blue Hill Pigeon.

This is the high-level pigeon found throughout Ladakh, including the Dras and Suru Valleys at elevations of from 10,000′ to 16,000′. They frequent rocky, precipitous ground, but often come down to feed in the fields or among stony ground by streams. They were observed drinking the brackish water of the Tsomoriri Lake.

They breed in holes in rocky cliffs, caves, etc., and several old nests were seen near the Tsomoriri and Tsokar Lakes in Rupshu at 15,500′. These nests were solitary, and fairly easily accessible. They are probably rather late breeders, as no eggs were seen in June.

181. Columba leuconota leuconota. The Snow Pigeon.

This is a common bird in the higher hills and valleys of Kashmir, being found to a less extent in the eastern slopes of the Himalayas, towards Ladakh, at the head of the Dras and Suru Valleys. They are generally to be seen in small flocks feeding on the grassy slopes, among rocks below the snow-line.

They breed in rocky precipices, often near rivers and streams between about 10,000′ and 13,000′.

182. Streptopelia orientalis meena. The Himalayan Turtle Dove.

This is a common species in the well-wooded areas on the slopes of the mountains throughout Kashmir, chiefly between 6,000′ and 10,000′ a few are also to be seen on the Ladakh side of the Himalayan Range in the Indus Valley as well as in the Suru and Dras Valleys, where they also breed.

The breeding season is from May to August. Nests are built in small trees or dense bushes in forest generally at no great height from the ground.

Eggs average 32·3 by 24·0.

183. Streptopelia decaocto decaocto. The Indian Ring Dove.

Very numerous in the Valley of Kashmir being found also up the side valleys to about 6,500′ only. This species is not found in Ladakh, except on migration. A party of about 10 birds was seen at Dras 10,000′ on May 2, but they move evidently only on passage.

They breed in the Valley at 5,000′ in May and June, the nests bieng placed in small trees or large bushes.

The eggs average 30·2 by 23·4.

184. Syrrhaptes tibetanus. The Tibetan Sand Grouse.

This species is found in the stony sandy desert areas in the higher parts of Ladakh. They were met with by the writer only in Rupshu near the Tsomoriri Lake where a pair of freshly hatched chicks in down were found on June 18.

About 10 pairs of these birds frequented the stony level plain at the south end of the lake, but no eggs were discovered.

185. Catreus wallichii. The Cheer Pheasant.

This is rather a local bird in Kashmir, not being found in the main Valley, but is believed to be not uncommon towards the Kishenganga and on the outer slopes of the Pir Panjal Range.

186. Lophophorus impejanus. The Monal.

This handsome pheasant is found generally distributed on the mountains surrounding the Kashmir Valley, in summer between 8,000′ and 11,000′. They are not common, except in the less frequented parts, e.g., the Kishanganga Valley, the Wardwan Valley, etc.

Young just able to fly were seen with their parents above Battal (9,000′) in the Sind Valley on June 29.

187. Pucrasia macrolopha biddulphi. The Kashmir Koklas.

Generally distributed but not very numerous in the big fir forests of northern Kashmir. They are chiefly found between 7,000′ and 10,000′. The ' crow ' of the male bird is similar to that of the common koklas. This latter bird is said to be found in South Kashmir.

188. Gennæus hamiltonii. The White-crested Kalij.

This pheasant is not found in the main valley of Kashmir nor on the surrounding hills. It occurs however in South Kashmir and on the outer lower slopes of the Pir Panjal.

189. Alectoris græca chukar. The Chukor.

Extremely common on the lower slopes of the hills bordering on the main valley, and found up to at least 11,000′. They afford excellent shooting in the cold weather months.

Breeding commences early in April. About 12 or 13 eggs are usually laid under a rock or bush often on a steep mountain slope, and generally well concealed. Eggs are laid at intervals of 48 hours. In one nest 21 eggs were found, probably the property of two hen birds !

Eggs measure as follows :—L., *46·3*×31·0. S., *37·9*×28·9. B., 44·4×*32·0*. N., 42·1×*28·0*. Average, 38 eggs, 42·1×30·7.

190. Alectoris græca pallescens. The Northern Chukor.

This chukor takes the place of the common chukor in the drier portions of Ladakh proper, and is found at elevations of from 9,000′ to 14,000′ more especially in the neighbourhood of cultivation. A pair of birds shot near Gya weighed respectively 18½ and 14 ounces, the male being the heavier bird.

A nest concealed at the base of a dwarf berberis bush near Khardong Pass at 13,000′ on the Shyok side of the Khardong Pass in Ladakh was discovered on July 22. It contained 12 nearly fresh eggs, indistinguishable from those of the common chukor.

They measure :—

L., *45·4*×31·4. S., *43·1*×30·9. B., 44·4×*31·6*. N., 43·4×*30·0*. Average of 12 eggs, 44·2 by 31·0.

191. Francolinus francolinus asiæ. The Northern Indian Black Partridge.

Not found in the Valley of Kashmir but occurs in the Jhelum Valley below Uri and on the outer lower slopes of the Pir Panjal Range.

192. Francolinus pondicerianus. The Grey Partridge.

Not found in the valley of Kashmir, occurs in the plains and foothills only.

193. Perdix hodgsoniæ hodgsoniæ. The Tibetan Partridge.

Found at high elevations, 14,000′ to 17,000′ in Ladakh, but is local and rare. It is not uncommon in Rupshu, especially from the Polokonka Pass down the Puga Valley, and also towards Hanle. It is found on rocky hillsides, especially in patches of caragana scrub.

194. Tetraogallus himalayenis himalayensis. The Himalayan Snow-Cock.

This large, handsome bird is found at high elevations throughout the mountains of Kashmir including the Pir Panjal Range. In Kashmir proper it is found from 12,000′ up to the snow line, and frequents open rocky or grassy slopes above the tree limit. It is also found in Ladakh especially Western Ladakh.

They are noisy and pugnacious birds in the spring. The call of the cock bird is of two kinds : (1) A clear whistle repeated 3 or 4 times at regular intervals of about a second, the notes rising in the scale so that the 4th or last note is an octave above the first. (2) A cry beginning with kuk, kuk, which is repeated about a dozen times, gradually quickening and also rising in the scale until the last high pitched notes follow each other so rapidly as to remind one of the acceleration of a ping-pong ball.

Two lots of eggs were brought to the writer from the hills above Leh at about 14,000′. They consisted of 7 slightly incubated eggs probably a full clutch, and two fresh eggs.

In the first lot the ground colour is cafe-au-lait, spotted and speckled all over with chocolate markings. In the second lot the ground colour is a dull pale green, and these are marked with pale pinkish brown.

The eggs vary in length from 71·0 to 62·5 and in breadth from 47·5 to 45·0, the average of one clutch being 70·7 by 47·2 and of the other 65·6 by 46·1.

195. Tetraogallus tibetanus tibetanus. The Ladakh Snow-Cock.

Occurs in Eastern and Southern Ladakh at even higher elevations than the last species, which it much resembles generally in its mode of life and habits,

196. Rallus aquaticus aquaticus. The Water Rail.

Common throughout the summer months and possibly resident in Kashmir. It is found throughout all the extensive jheels such as Hokar Sar, Anchar Lake, etc. They call chiefly in the early morning, a curious cry somewhat reminding one of the squeal of a small pig. They are extremely shy and wary keeping to long grass and reeds standing in shallow water.

They breed throughout June, July and August, 6 to 8 eggs being laid in a nest composed of reed-leaves on the ground in a swamp well concealed in standing grass and water plants.

The birds are difficult to flush and specimens are therefore difficult to obtain.

The eggs are pale cafe-au-lait rather sparingly spotted—chiefly at the broad end, with pinkish brown. They measure :—

L. ... *40·9* × 26·1 B. ... 36·6 × *27·1* } Average of 34 eggs, 36·3
S. ... *33·2* × 23·5 N. ... 33·2 × *23·5* } by 25·6.

197. Porzana pusilla pusilla. Eastern Baillon's Crake.

This is a common bird in the Valley of Kashmir, being found throughout the summer months in all the swamps, edges of lakes, etc. It is however much more frequently heard than seen, being a skulker in grass and swamp vegetation, and one that is flushed with difficulty. On one occasion, when searching for nests of this bird, one was seen running through the grass at the writer's feet and was mistaken for a rat. It was captured in the hand with some difficulty.

Nests are placed on the ground, in a swamp, well concealed in comparatively short grass and dwarf rushes, etc.

From five to eight eggs are usually laid from May to August which are dull greenish brown in ground, mottled with dusky brown on markings.

They measure :—

L. ... *30·3* × 21·0 B. ... 28·7 × *21·5* } Average of 82 eggs, 28·4
S. ... *26·6* × 20·3 N. ... 27·9 × *19·2* } by 20·6.

198. Amaurornis fuscus bakeri. The Northern Ruddy Crake.

This species is even commoner than the last being found in paddy fields as well as in swamps. In its skulking habit it resembles *Porzana.* Breeding commences in June, but July and August are the chief months.

Nests are composed of dry grass and the leaves of aquatic plants placed on the ground among grass, reeds or rice plants.

Six to 9 eggs are laid which are pale cafe-au-lait spotted all over chiefly at the broad end with pinkish-brown and pale purplish-grey markings.

Eggs measure :—

L. ... *35·4* × 24·0 B. ... 32·0 × *24·5* } Average (92 eggs), 32·6
S. ... *29·6* × 21·6 N. ... 29·6 × *21·6* } by 23·5.

199. Gallinula chloropus parvifrons. The Indian Moorhen.

Very common on all the lakes and larger jhils in the main valley, especially where beds of bulrushes abound, as in the Dal and Anchar Lakes.

In their habits they do not differ from the common moorhen of Europe.

Breeding commences in May and extends on into July. Eight or 9 eggs are commonly laid, but occasionally as many as 12. They resemble those of the Western Moorhen.

The nest is composed of a mass of bulrush leaves and is placed in dense patches of standing bulrushes, about a foot above the level of the water.

Egg measurements are as follows :—

L. ... *45·8* × 31·6 B. ... 44·8 × *32·9* } Average (71 eggs), 41·4
S. ... *38·3* × 28·0 N. ... 39·0 × *27·4* } by 29·6.
(A pigmy egg measures 22·5 × 18·5)

200. Fulica atra atra. The Common Coot.

Not uncommon on the lakes and jhils of the main valley, but not nearly so numerous as the Moorhen. A nest of the usual type was found in rushes on the Anchar Lake on May 20. It contained 8 eggs which measure (average) 52·4 by 35·0.

201. Porphyrio poliocephalus poliocephalus. The Purple Coot.

A rare bird in Kashmir, but a few are usually to be found in the Anchar and doubtless other lakes in the valley. They undoubtedly breed in Kashmir but I have not seen a nest.

202. Megalornis nigricollis. The Black-necked Crane.

Occurs in Ladakh, in summer, at high elevations wherever the conditions are suitable. Three birds were seen early in June near the Tsokar Lake in Rupshu at 15,000′, and a pair near the Tsomoriri Lake at the same elevation in the third week of June. They did not appear to be breeding then. Later in the first week of July several pairs were seen in the swamps near Shushal at 14,000′ east of the Indus, but no nests were seen and no young birds. They undoubtedly breed in these swamps, but exactly when I was unable to ascertain.

The call of these birds is trumpet-like and resembles that of the Sarus Crane.

203. Hydrophasianus chirurgus. The Pheasant-tailed Jacana.

Fairly common throughout the summer months on the extensive jheels and weedy lakes in the main valley, especially in Hokar Sar and the Anchar Lake. The cry of the bird is loud and peculiar.

Breeding commences in May and continues until July, the eggs usually 4 in number but sometimes only 3, are peg-top shaped and of a dark olive-brown colour.

The nest is a slight accumulation of aquatic plant stems, placed in among floating plants, the eggs being only just above the water level.

Eggs measure :—
L. ... *38·7* × 28·1   B. ... 36·2 × *28·8* } Average (14 eggs), 37·2
S. ... *35·0* × 28·0   N. ... 36·6 × *26·4* } by 27·8.

204. Lobivanellus indicus indicus. The Red-wattled Lapwing.

The ' Did-he-do-it ' is not a common bird in Kashmir, but it is found occasionally in the main and larger side valleys up to about 6,000′.

A nest found near Shalabug in damp waste land contained four fresh eggs on May 25. The average measurement of these eggs is 42·9 by 31·1.

205. Vanellus vanellus. The Peewit.

A not every common winter visitor, found in the neighbourhood of wet ground in the main valley.

206. Charadrius mongolus atrifrons. The Central Asian Lesser Sand-Plover.

This pretty little plover is not uncommon in South and East Ladakh in summer between 13,000′ and 15,500′. They are found near lakes and streams as well as along the Indus River, and are very partial to stony or sandy plains provided water is not too far away.

The note of this bird is a peculiar one, a vibrating call, reminiscent of the note of the ice-bird (*Caprimulgus indicus*).

These birds were found breeding in Rupshu near the Tsokar and Tsomoriri Lakes (about 15,000′.) On the Indus at 13,000′ between the Indus and Shushat at 14,000′ to 14,500′ and along the Pangkong Lake at 14,000′. They were also found breeding in the upper portion of the Suru Valley at about 13,000′.

Egg laying commences about the middle of June and continues to the middle of July.

Three eggs only are laid in a slight depression scraped in the sand among stones or shringle.

The nest or rather nest cavity, for there is no nest, is very difficult to locate. The parent bird if disturbed by the approach of a man when incubating, gets up off the eggs very quietly and slinks away with lowered head after the manner of many other plovers. When returning toits eggs the approach is made very cautiously, and great care is necessary, even with the aid of a pair of field glasses, not to lose sight of the bird in the stretch of sand and stones among which it moves in a series of short runs.

The eggs are slightly pyriform and without gloss. The ground colour is café-au-lait, sometimes with a distinct warm tinge, speckled more or less all over with dark brown markings.

Eggs vary in length from 38·2 to 35·4 and in breadth from 27·2 to 25·6, the average of 12 eggs being 36·7 by 26·3.

207. Charadrius dubius jerdoni. Jerdon's Little Ringed Plover.

Not very common in Kashmir, but found by some of the larger streams where they enter the valley. A nest with four fresh eggs was found by the Sind River near Ganderbal (5,000′) on sandy, shringly ground on May 28. They also breed earlier than this, as on the same date a fully fledged young bird was observed.

The eggs are drab or pale khaki in ground finely speckled with very dark brown. They measure (average of 8 eggs), 28·9 × 21·5.

208. Himantopus himantopus himantopus. The Black-Winged Stilt.

This bird is not common in the Valley of Kashmir and its distribution is local. The only place where the writer met with this species was in swampy ground near the mouth of the Lidar River, but they undoubtedly occur in other parts of the valley.

They breed in the swamps in the valley.

209. Ibidorhynchus struthersi. The Ibis Bill.

This remarkable bird is not rare on some of the larger rivers of Kashmir and Western Ladakh. They frequent stony, sandy shores and especially islands. They emit when disturbed, a rather shrill mournful cry, something resembling that of the green shank.

They breed on stony, sandy islands often difficult of access in the summer, owing to the swollen condition of all streams from the melting snow. They were observed breeding on the Sind and Lidar Rivers at from 7,000′ to 8,000′ and again on the Ladakh side of the Himalayas in the Suru Valley from 9,000′ to nearly 12,000′.

Eggs, usually 4 in number, are laid in May and June on islands of sand, shingle and stones, with or without bushes of tamarisk, etc. The eggs are large for the bird, broad ovals, the ground colour being drab grey, and they are spotted and speckled, chiefly towards the broad end, with dark brown.

The eggs are laid in a slight depression in the sand, excavated by the parent bird, among stones or shingle. The nest cavity, in one instance, was found completely surrounded with hundreds of small stones, the size of a small split pea.

Two eggs found in the Lidar River (a full clutch) on June 14 (probably a second nest, the first having been destroyed by a flood) measure 49·8 × 38·6 and 52·0 × 38·9 respectively.

210. Tringa hypoleuca. The Common Sandpiper.

Common in Kashmir throughout the summer months breeding up all the chief streams and rivers, and especially in the Sind and Lidar, between 6,000′ and 9,000′. They also breed on the Ladakh side of the Himalayan Range in the Dras and Suru River beds from 9,000′ to 11,000′.

Eggs are laid during May and June chiefly on low islands in mid-stream, especially such as bear low shrubby vegetation of tamarisk, coarse grass wild indigo, etc. Nests are composed of dry leaves and grass scraped together in a depression under the shelter of some small tamarisk or indigofera bush and are well concealed.

Eggs, 4 in number, are pyriform and slightly glossy, creamy white, spotted chiefly at the broad end with reddish-brown and sepia markings.

They measure :—L., *37·5* × 25·6. S., *32·5* × 25·2. B., 35·5 × *26·7*. N., 32·5 × *25·2*.

Average of 16 eggs, 35·5 × 26·0.

211. Tringa glareola. The Wood Sandpiper.

A fairly common winter visitor to the Valley of Kashmir.

212. Tringa ochropus.

Seen cheifly on the spring and autumn migration, both in Kashmir and Ladakh. They apparently return very early from their breeding haunts, birds having been noted in the Suru Valley at 12,000′ as early as July 18.

213. Tringa totanus eurhinus. The Eastern Redshank.

A not uncommon winter visitor in the Valley of Kashmir, breeding in Ladakh in swamps at from 13,000′ to 15,000′.

They are wild and wary birds and their nests which are generally placed in tussocks of grass in a swamp are difficult to locate.

They were found breeding by the Tsokar Lake and in the Puga Valley, at 15,000′ and 14,000′ respectively, in Rupshu. Also in the extensive swamps near Shushal, at 14,000′ and in the Rungdom swamps at 13,000′ in the Suru Valley.

Eggs both fresh and incubated, were taken in the first week of July near Shushal, and freshly hatched young in down were also seen. Eggs are elongated, pyriform and rather glossy, pale yellowish cafê-au-lait, marked with dark reddish-brown, chiefly at the broad end.

They vary in length from 48·9 to 43·9 and in breadth from 33·0 to 31·2, the average of 8 eggs being 46·1 by 31·8.

214. Tringa nebularia. The Greenshank.

A not uncommon winter visitor to the main valley.

215. Philomachus pugnax. The Ruff and Reeve.

A regular winter visitor but rather rare.

216. Erolia temminckii. Temminck's Stint.

A small party met with by the Indus River in Ladakh in May at 11,000′.

217. Erolia minuta. The Little Stint.

Occasionally seen in small parties on mud flats by the Jhelum River and Wular Lake in autumn and winter.

218. Scolopax rusticola rusticola. The Wood-Cock.

A resident in Kashmir but not so common as in Kulu and Garhwal.

In the summer they are found in fir and mixed forest, chiefly on northern aspects, both on the Pir Panjal and Himalayan Ranges, but especially the former and also in the Kishanganga Valley.

They breed in June and July at from 8,000′ to 10,000′. A nest near Gulmarg was in silver fir forest among dead leaves, etc., in the shelter of a skimmia bush. It contained 3 incubated eggs on July 20.

Eggs are dull whitish in ground marked with large pale reddish-brown and grey blotches.

The average of 5 eggs is 40·9×33·8.

219. Gallinago gallinago gallinago. The Fantail Snipe.

This is mainly a bird of passage, being found in fairly large, but varying, numbers, in the main valley in the early spring and late autumn, a certain number of birds remaining to breed. By April and early May birds may be seen 'drumming' over the marshes around the Hokra Jhil, which is carefully preserved.

Fresh eggs, four in number, may be found in these swamps from the middle of May. They are pale greenish-buff in ground, more or less richly marked with umber brown and grey spots and blotches. Eggs give the following measurements :—

L *39·0*×27·2. S., *35·7*×25·6. B., 36·5×*27·7*. N., 38·8×*25·9* (average, 29 eggs), 37·1×26·8.

220. Lymnocriptes minima. The Jack Snipe.

A fairly common winter visitor.

221. Rostratula benghalensis benghalensis. The Painted Snipe.

This species is common and resident in the swamps of the main valley. They are found breeding in the Hokra Jhil along with the common snipe.

They chiefly breed in May, the nest being placed in similar situations to that of the common snipe. Although the bird is larger than the common snipe its eggs are decidedly smaller. They are yellowish in ground boldly and heavily marked with dark brown almost black blotches, and are glossy.

They measure :—
L., *37·0*×25·2. S., *32·8*×24·8. B., 35·8×*27·2*. N., 33·4×*23·6*. Average, 43 eggs, 35·4×25·3.

222. Larus ridibundus ridibundus. The Black-headed Gull.

A common winter visitor in the valley, especially in the vicinity of the Wular Lake.

223. Larus brunnicephalus. The Brown-headed Gull.

This gull is occasionally seen in the Valley of Kashmir as a cold weather visitor. In the spring they leave for higher altitudes and in summer they are found breeding in coloniesin Ladakh by the salt lakes. In Rupshul, by the Tsokar and Tsomoriri Lakes they are fairly numerous, but no eggs had been laid up to June 21st, but judging from the behaviour of the birds, they were then about to commence breeding. The cry of these birds on their breeding grounds is very like that of the jungle crow.

A few birds were seen near the Pangong Lake in July but no breeding colony was met with.

224. Chlidonias leucopareia indica. The Indian Whiskered Tern.

Exceedingly common throughout the summer on all the lakes and larger jhils in the Valley of Kashmir. Most of the birds arrive in April and breeding commences towards the end of May.

Two or three eggs are laid on an apology for a nest consisting of a collection of the stems of water plants among floating water lilies, lotus and other aquatic plants. The nests rise and fall with the water, upon which they float, and the eggs are usually only a fraction of an inch above the water level.

Two or three eggs constitute a full clutch, but four or five have more than once been found in one nest, but in such cases the eggs were evidently the joint property of two hen birds. The eggs vary in size and colour to a great extent. They are, in ground, usually some shade of yellowish-brown or pale green, marked chiefly in a zone at the large end with deep brown chocolate brown or purplish sepia spots. The eggs are collected in large numbers by the villagers and sold to the European visitors in Srinagar as 'Plovers' eggs!

Eggs measure as follows :—
L., *41·8*×27·0. S., *32·8*×26·7. B., 38·2×*29·5*. N., 33·8×*25·6*. Average (72 eggs), 37·0×27·4.

225. Sterna hirundo.

A tern which is either *S. h. hirundo* or *S. h. tibetana* was seen fairly frequently by the Tsomoriri Lake in Rupshu, at Puga, on the Indus and along the Pangong Lake between 13,000′ and 15,000′. This was in June and July. They were also seen in July on the upper reaches of the Suru river at about 13,000′. They evidently breed in all these localities, but no nests were seen.

226. Phalacrocorax carbo sinensis. The Indian Large Cormorant.

Common in the lakes and larger jhils in the Valley of Kashmir. Probably resident.

227. Plegadis falcinellus falcinellus. The Glossy Ibis.

A solitary bird was seen feeding by the Dras River, near Dras, at 10,000′ on May 3. It was evidently a straggler.

228. Ardea cinerea cinerea. The Common Grey Heron.

Very common and resident in the Valley of Kashmir, being found near all the lakes and larger jhils, and penetrating up the larger side valleys, e.g. the Lidar up to about 7,000′.

They breed in colonies in the largest and most inaccessible chenar trees. Breeding commences in March, at which time many fresh eggs may be found lying broken below the trees in which they are nesting. Possibly these eggs are ejected in the struggle for nesting sites.

229. Ardeola grayi. The Indian Pond Heron.

This bird is locally common, e.g. on the Anchar Lake where they are resident.

They breed in May in the willows around the edges of the lake, usually in small colonies.

Four or five eggs are laid, which are blue and glossless.

Eggs measure :—
L. ... *41·0* × 29·6 B. ... 36·1 × *30·1* } Average (27 eggs), 38·0 by
S. ... *35·6* × 29·21 N. ... 35·0 × *27·0* } 27·9.

230. Nycticorax nycticorax nycticorax The Night Heron.

Very common in the lakes and larger jhils in Kashmir.

They breed in large colonies, either alone or in company with the grey Heron, in May, laying 4 eggs similar in colour to those of the pond heron.

They measure :—
L. ... *52·7* × 35·9. B. ... 52·3 × *36·2* } Average (18 eggs), 49·5 by
S. ... *46·7* × 33·3. N. ... 49·4 × *32·8* } 34·8.

231. Ixobrychus minutus minutus. The Little Bittern.

Extremely common in the beds of bulrushes in the Dal and other lakes and jhils in the valley.

They breed throughout May and June in the bulrush beds, which stand in water about 2 feet deep. The nests are composed of the leaves of the rush and are attached to the rushes about a foot above the water level. From 5 to 7 eggs are laid which are rather elliptical in shape, pure white and glossless.

They measure :—
L. ... *37·4* × 24·7 B. ... 35·8 × *27·2* } Average (78 eggs), 34·5 by
S. ... *32·1* × 25·7 N. ... 35·3 × *23·7* } 25·5.

232. Botaurus stellaris stellaris. The Bittern.

This is not a common bird in Kashmir but it occurs in some of the denser, more extensive reed beds e.g. near Shalabug. The natives assured me that they had found the nest and eggs on several occasions and it is probable that the bird does breed in the valley though I failed to find a nest.

233. Anser anser. The Grey Lag Goose.

Visits the Kashmir Valley in winter in huge flocks.

234. Anser albifrons albifrons. The White-fronted Goose.

Also a winter visitor to Kashmir, but not usually common.

235. Anser indicus. The Bar-headed Goose.

This small goose is found in fairly large numbers in Ladakh in summer where they breed between 12,000′ and 15,000′. Eggs are laid from the last week in May to the first week in June. They were found breeding near the Tsokar and Tsomoriri Lakes in Rupshu at 15,000′ elevation between the June 8 and 21. A colony of 15 pairs had nests on a silt island in the Tsomoriri lake. The nests were in slight depressions scraped in the silt or 3″ or 4′ above the water level and were not concealed, the island being absolutely devoid of vegetation.

Six appears to be the maximum full clutch. The eggs are large for the size of the bird ; a goose shot from the nest weighing 4½ lbs. and her 6 eggs, 29 ounces !

They are rather elongated ovals, pale creamy white where fresh, but becoming much discoloured as incubation proceeds. When islands are not available as nesting sites, these birds will lay on rocky cliffs. One such nest was found in a deserted raven's nest on a vertical cliff near the Tsokar Lake. In every case the eggs are surrounded or covered with down.

Other breeding localities noticed were the Indus River near Nimu Mut (13,500′) and a small swampy lake near Shushal at 14,200′.

Egg measurements give the following figures :—
In length, from 87·2 to 72·3. In breadth from 58·5 to 51·2.
Average 47 eggs, 82·6 by 55·3.

236. Casarca ferruginea. The Brahminy Duck.

A not very common winter visitor to Kashmir, retiring to Southern and Eastern Ladakh in summer to breed. Fairly large numbers were found breeding in the hills in Rupshu around the Tsokar and Tsomoriri Lakes, as well as at Puga.

Breeding commences early in May, ducklings being first observed on the water on June 12.

Nests are usually at a considerable distance from the water, in holes in the rocky hillside or among boulders, on rocky cliffs. The young ducklings are brought down to the water by their parents as soon as they are hatched. They appear to bring them down two at a time, for on one occasion I saw a pair fly down from the hills and alight on the water and then noticed they had 2 ducklings with them. I did not unfortunately see how the transportation was effected.

When at Puga, in Rupshu, where there are hot springs and sulphur and borax deposits, I saw many families of these ducklings running about among the swamps. They were of various ages—some very young, others fully 2 or 3 weeks old, but none could fly. This was on June 26. The maximum number of ducklings in one family was 8. No eggs were found.

237. Anas platyrhyncha platyrhyncha. The Mallard.

One of the commoner ducks which visit Kashmir in the winter. A fair number of birds remain in Kashmir to breed.

Breeding commences about the middle of April and fresh eggs may be found throughout April and May.

The nest is usually well concealed in reeds or rushes—as many as 12 eggs are laid which are very pale greenish ' khaki ' in colour.

They measure :—

L., *59·4* × 42·2. S., *53·2* × 41·2. B., 58·3 × *42·4*. N., 55·2 × *39·2*. Average (11 eggs) 56·3 by 41·3.

238. Chaulelasmus streperus. The Gadwall.

A fairly common winter visitor.

239. Mareca penelope. The Wigeon.

Also fairly common in winter.

240. Querquedula querquedula. The Garganey.

Common on the spring and autumn migrations.

241. Nettion crecca crecca. The Common Teal.

Very numerous throughout the winter months. A few are occasionally seen also in summer and possibly they may rarely breed in the valley. These are probably ' pricked ' birds.

242. Dafila acuta. The Pintail.

Common on the spring and autumn migrations. A few birds remain throughout the winter.

243. Spatula clypeata. The Shoveller.

Fairly common in the winter.

244. Marmaronetta angustirostris. The Marbled Duck.

Rather a rare winter visitor. I have only seen two birds shot in three years.

245. Netta rufina. The Red-crested Pochard.

Common in winter.

246. Nyroca ferina ferina. The Dunbird.

Fairly common in winter.

247. Nyroca marila marila. The Scaup.

A rare winter visitor.

248. Nyroca rufa rufa. The White-eyed Pochard.

Common and resident. Breeding commences in May, and fresh eggs may be found throughout May and June. The nest is placed on or near the ground in dense reeds, grass or bulrushes and is well concealed. About 11 eggs is the full clutch. They are coloured a rather warm café-au-lait.

Egg measurements are as follows :—

L., *53·2* × 37·6. S., *48·3* × 36·3. B., 52·7 × *37·9*. N., 49·1 × *35·3*. Average (27 eggs), 50·5 by 36·9.

249. Nyroca fuligula. The Tufted Pochard.

Not uncommon on the spring migration.

250. Glaucionetta clangula clangula. The Golden-eye.

A rare winter visitor.

251. Erismatura leucocephala. The Stiff-tailed Duck.

Not common but a regular winter visitor.

252. Mergus albellus. The Smew.

Not common, but occasionally seen in the winter months on the Wular Lake. Colonel Ward found them breeding on the Shyok river in Ladakh.

253. Merganser merganser orientalis. The Eastern Goosander.

Occasionally seen in Kashmir, it is a regular summer visitor to Ladakh where it breeds on the Indus river and near the lakes in Rupshu, as well as near the Pangong lake in June.

254. Podiceps cristatus cristatus. The Great Crested Grebe.

Rare in Kashmir (I have seen one bird shot). They were found breeding in a colony by Col. Meinertzhagen by the Tsokar Lake at 15,000′ in Rupshu (Ladakh).

255. Podiceps ruficollis albipennis. The Indian Little Grebe.

Very common throughout the Kashmir Valley in jhils and reedy lakes in summer. Not nearly so numerous in winter.

Breeding commences from early May and continues till July. From 4 to 6 eggs are laid which are pure white the day they are laid, but they very rapidly become stained, but not uniformly a dirty brown, occasionally they may even become a deep chocolate.

The eggs are laid on a floating mass of decaying vegetable matter collected by the birds, and the eggs are only raised an inch or so above the water. When the parent bird leaves the nest she covers the eggs with a portion of the nest material.

Eggs give the following measurements :—

L., *38·8* × 26·0. S., *34·3* × 25·1. B., 36·3 × *26·3*. N., 38·8 × *23·2*. Average (32 eggs), 36·6 by 25·1.

ON THE BREEDING HABITS AND FECUNDITY OF THE SNAIL *LIMNÆA LUTEOLA*.[1] LAMARCK (FORMA-TYPICA)

BY

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(*With two plates and two graphs*)

The breeding habits and fecundity of *Limnæa luteola* Lamarck forma typica [2] were the subject of my observations during the past three years. The observations were made on (1) individuals reared in the aquaria in the laboratoy, (2) individuals kept isolated in the laboratory, (3) individuals kept in big troughs of water in the open air (in a garden), and (4) individuals in their natural haunts.

The species in question is the only species available in Tirupati and my observations are practically confined to it. But I had an occasion once to get live specimens of *Limnæa acuminata* from elsewhere and they also were under observation for some time. So far as fecundity is concerned *Limnæa acuminata* also presents the same features as *Limnæa luteola.*

Limnæa luteola seems to attain sexual maturity in about ten months. It is not definitely known how many times an individual breeds during its lifetime. In attempting to find out this, two difficulties were experienced. One was that the exact duration of life of individuals could not be definitely ascertained, for the adult individuals could not be kept alive in the aquaria for over five or six months in spite of all possible care bestowed on them. Young individuals hatched from the eggs could however be kept alive much longer. But from observations made on the rate of growth of the individuals, on the size attained in a year by individuals kept under natural conditions in open surroundings, and judging from the maximum size attained by individuals we may assign to this species of *Limnæa* three years as the duration of life. On the strength of my observations, I can confidently assert that it is more than two years.

The other difficulty was that of ascertaining the exact breeding season. I could collect eggs at all times of the year. At first it seemed as though the species was breeding right through. But I kept the individuals isolated in the laboratory and observed that they breed for about four to five months. Individuals lay eggs in abundance for a time and then gradually cease their breeding. That eggs are found in abundance at all times of the year is to be explained as due to different sets of individuals reaching sexual maturity at different periods of the year, and thus some individuals or other in a tank are found breeding right through. We cannot therefore speak of any definite breeding season for this species of *Limnæa.* The individuals of the species have each their own breeding period of life, but there seems to be no breeding season for the species as a whole.

Limnæa is of course oviparous like the majority of *Mollusca*. An individual about to lay eggs attaches itself by its foot to a leaf, or in the aquarium, to the wall of the aquarium. It remains steady for a short while and as the mass of eggs embedded in the jelly-like substance issues out, the animal recedes very slowly. It takes about twenty to twenty-five minutes for an animal to lay a batch of about 120 eggs.

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[1] From a paper read before the Indian Science Congress (1927) held at Lahore.

[2] My thanks are due to Major Seymour Sewell and Dr. H. S. Rao for the identification of species.

The eggs are laid as indicated above in capsules embedded in a jelly-like gelatinous substance. This jelly is more abundant than in the case of egg masses of *Indoplanorbis exustus* and the egg capsules are unlike those of *Indoplanorbis exustus* in not being tough. Each batch of eggs contains usually three or four rows of oval eggs capsules. The egg masses are laid on some substratum like leaves, stones, shells of other *Mollusca* like *Vivipara*, *Pila globosa*, etc. The length of the batch varies according to the number of eggs. I have often come across batches nearly 2″ long. The average number of eggs in a batch is about thirty-two.

For observations on their fecundity, I kept a number of individuals isolated. The statistics for the frequency of laying eggs and for the variation in the number comprising a batch are given in the end. It will be sufficient here to refer simply to the general feature of the fecundity of *Limnæa luteola*.

(1) Average frequency of laying eggs per individual :—Once in two days.

(2) Average number of eggs individuals per batch :—Thirty-two.

Generally speaking an individual under normal conditions lays eggs once in about two to three days, sometimes more frequently, sometimes with regularity. In the course of about three months an individual could lay as many as forty-seven batches. The average number of eggs per batch for this individual was thirty-four.

Mr. Ramanan [1] speaking of the Madras specimens, says that the spawn was laid once in a fortnight. Professor J. A. Thomson[2] speaking of *Limnæa stagnallis* says, ' the eggs are laid through the summer and attached in clumps of about thirty to water weed, each clump being surrounded by a curved mass of jelly about an inch long. . . . They hatch out in a month.' It is evident that *Limnæa luteola* of Tirupati differs in these respects not only from its British cousin but also from the Madras one, for in the species under consideration, eggs hatch out in about ten days and the eggs are laid throughout the year.

The number of eggs in the successive batches laid by an individual alternately rises and falls—(*vide* statement and the graph, page 160). If, for example a large number of eggs, say fifty in number, are laid in a batch, the number in the next batch will be something less ; and after one to three batches it usually goes up again, only to fall again. Below are noted the number of the eggs in the successive batches laid by an individual. More or less the same phenomenon has been noted in a large number of individuals.

Batch No.	No. of eggs	Batch No.	No. of eggs
1	39	14	28
2	54	15	6
3	39	16	21
4	20	17	30
5	60	18	30
6	39	19	42
7	45	20	25
8	29	21	30
9	51	22	16
10	33	23	23
11	21	24	29
12	35	25	19
13	52		

Another feature worth noting and which has been observed in some of the individuals examined, is that with the increase in the number of batches laid by the individual, the number of eggs in the batch generally tends to decrease. The following figures show the average for every successive batches of eggs laid by an individual.

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[1] *Non-marine Mollusca of Madras and Its Vicinity* by V. V. Ramanan (1900), Premier Press, Madras.

[2] *The New Natural History*, by J. A. Thompson, page 906 (1926). George Newnes, Ltd., London.

1st five batches	42
2nd ,, ,, ...	38
3rd ,, ,, ...	33
4th ,, ,, ...	25
5th ,, ,, ...	25

It is clear that the average tends to fall with the rise in the number of batches laid by the individual.

Taking three years as the minimum duration of life of *Limnæa* it is possible to estimate the number of eggs laid by a single individual. An individual seems to breed for about four months in the year, though all the individuals in a tank do not breed at the same time of the year. During these four months about forty to fifty batches of eggs are laid, with about thirty-two eggs in each batch on the average. Thus in three years a single individual might lay about five thousand eggs. This is quite a prolific breeding. In their natural environment the breeding appears to be more prolific, for, I come across egg masses which are often much longer than those laid in captivity. Ordinarily one embryo is contained in an egg, but rarely two, three, seven or even nine embryos are found. The young ones hatch in about ten to eleven days in the cold season and in about nine to ten days in the summer season.

Limnæa are hermaphrodite. Annandale and Prashad [1] state that certain species are functionally protandrous and pair when the male organs are ripe. Annandale and H. S. Rao [2] state that they have much indirect evidence to show that this condition prevails in most species. They also state that prostrate and spermatheca are fully developed in the same individual only rarely and that egg masses are rare in tanks in which the snails are mating and conversely, when individuals are mating, egg masses are not common. I cannot speak the same of the species in Tirupati. I find the egg masses are common right through the year but the mating of the individuals takes place only from March to August. That is, even when the individuals are mating, the egg masses are quite plenty. I have closely watched the mating individuals and after separating them immediately after mating, kept a record of their subsequent behaviour.

First as to mating :—Of the two individuals that pair one is frequently slightly bigger and this is usually the functional male. The other is a little bit smaller and is the functional female. The copulation between the individuals lasts for about forty minutes and is not reciprocal. The individuals that are to mate come to the surface of the water. The functional female attaches itself by means of its foot to some foreign object, the side of the jar in my aquarium, and remains steady. The other individual attaches itself to the shell of the former and protrudes the whitish penis sheath and introduces it into the other animal. The movements of the penis as the sperm passes along are clearly visible through the translucent penis sheath. The mantle opening which can be seen by the side of the penis sheath is opened about every three minutes to renew the air in the mantle cavity. Sometimes the air is renewed at much longer intervals. On one occasion three individuals were found copulating together. Sometimes both float to the surface.

After mating both the individuals sometimes lay eggs that very day : sometimes one day or two later but never much later. So we cannot always conceive of the sperms being stored up for any length of time before the ova are fertilized.

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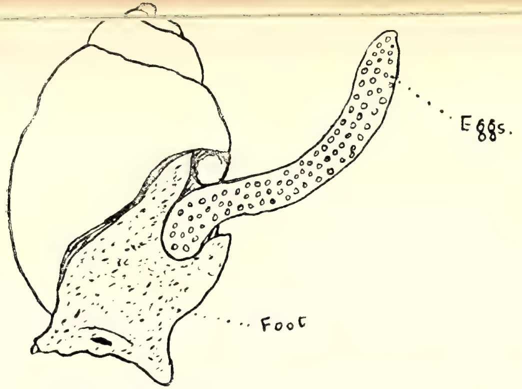
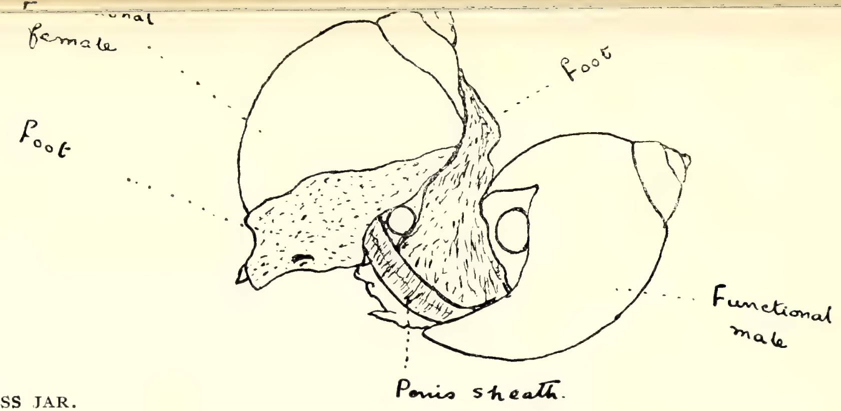
[1] *Records of the Indian Museum*, vol. xxvii, p. 138 (1925).

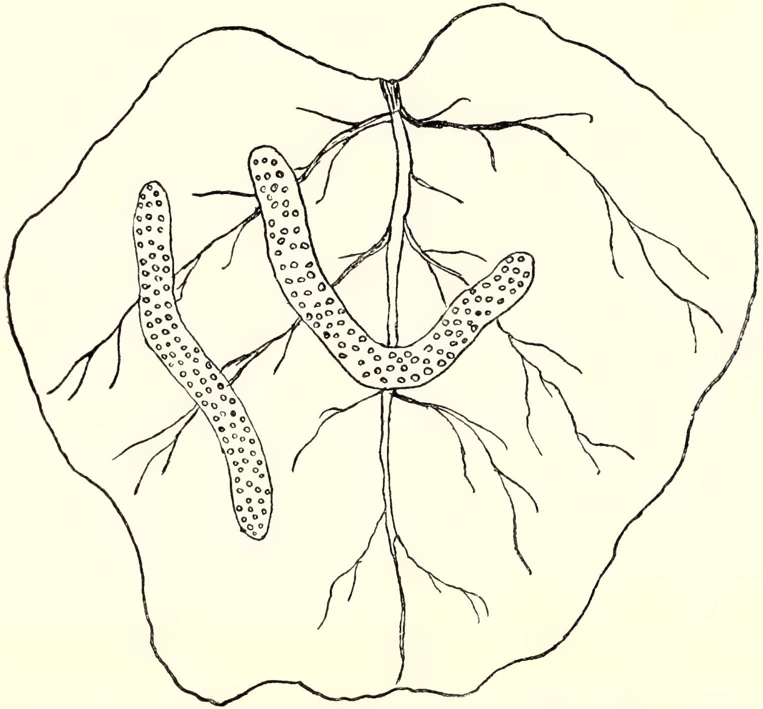
[2] *Ibid.*



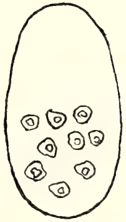
1. *Limnæa* LAYING EGGS ON THE SIDE OF A GLASS JAR.


female
Foot
Foot
Functional male
Penis sheath.

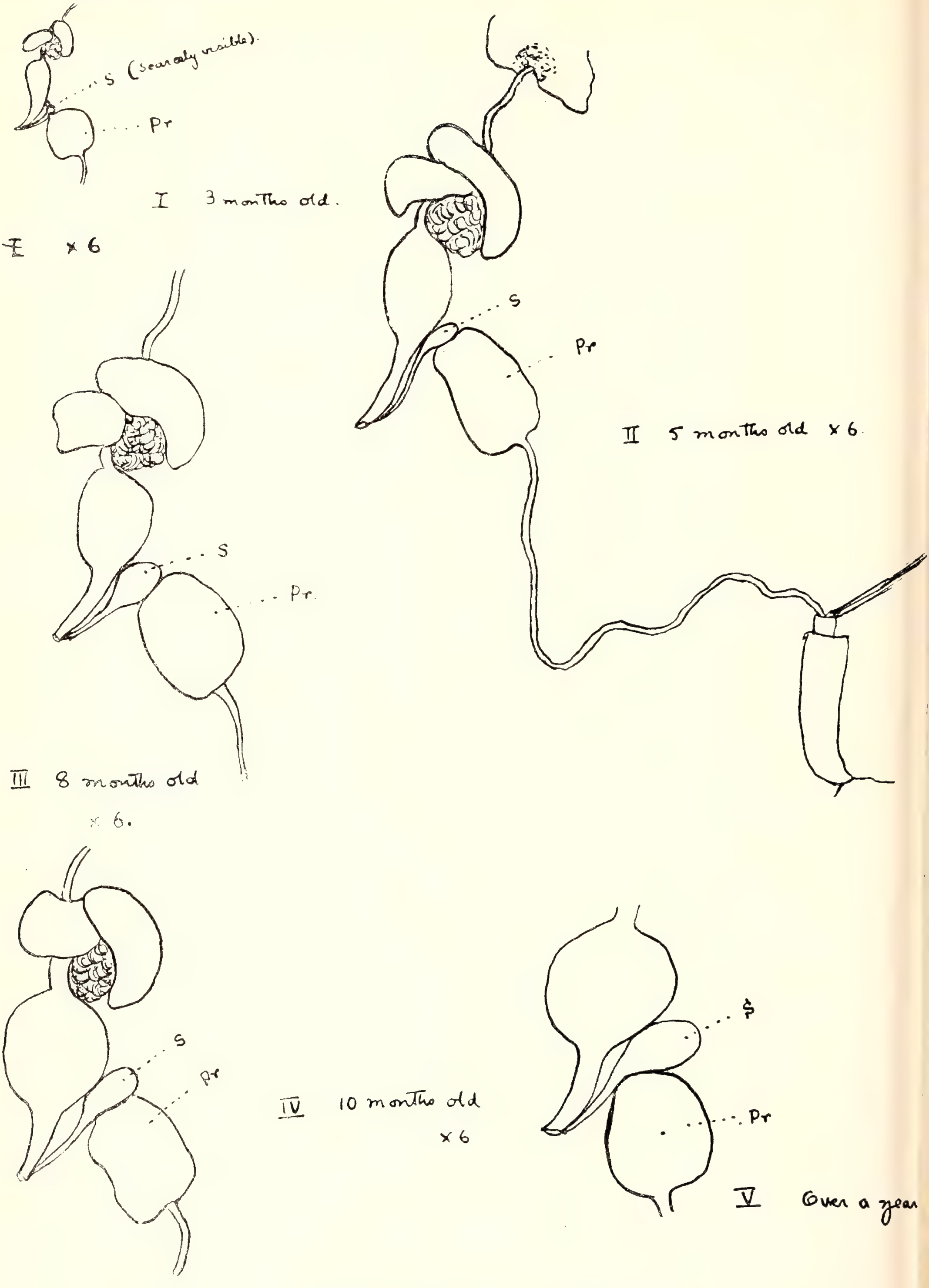
3. MATING IN *Limnæa luteola*.



2. EGGS LAID ON THE UNDER SURFACE OF A FLOATING PIECE OF LEAF.



4. EGG WITH NINE EMBRYOS.


S (scarcely visible).
Pr
I 3 months old.
I × 6
S
Pr
II 5 months old × 6.
S
Pr.
III 8 months old
× 6.
S
Pr
IV 10 months old
× 6
S
Pr
V Over a year

Pr. = Prostrate Gland ; S. = Spermatheca.

SKETCHES SHOWING RELATIVE DEVELOPMENT OF MALE AND FEMALE GENITALIA AT DIFFERENT PERIODS OF LIFE.

Below is the record of two individuals that mated on the 23rd August, 1925.

COPULATING INDIVIDUALS

Date	Functional female No. of eggs	Functional male No. of eggs
23rd August, 1925	23	27
24th ,, ,,	...	...
25th ,, ,,	...	...
26th ,, ,,	...	49
27th ,, ,,	20	...
29th ,, ,,	17	24
31st ,, ,,	17	13
2nd September, and so on	16	19
	25	21
	29	16
	16	15
	11	15
	12	18
	7	13
	9	12
	6	16
	died	13
		12
		3
		5
		9
		3
		4

Then again the reproductive organs of two mating individuals were examined. In the functional female the prostrate and the spermatheca were both well developed. The spermatheca and its duct contained sperms. The hermaphrodite gland showed sperms and ova well developed.

In the functional male also both the spermatheca and prostrate were well developed but in the spermatheca there were no sperms as in the functional female.

This would show that in both the mating individuals both sperms and ova are ripe and the male and female genitalia are equally ripe. And we have already seen that both the mating individuals begin to lay eggs soon after mating.

A few individuals that had been laying eggs for a long time were examined. They showed both sperms and ova well developed in the hermaphrodite gland. The spermatheca also contained sperms.

Young individuals of about four months or a little younger were examined. The spermatheca was minute and the uterus was small. In the hermaphrodite gland, sperms were developing but no ova. Again individuals of about 7 or 8 months were examined. The spermatheca was not yet of its maximum size but the prostrate was well formed. The hermaphrodite gland showed sperms but ova were not quite ripe.

Individuals are certainly protandrous in the first year of their life, but considerable time does not lapse between the development of the two sets of genitalia. In older individuals both ova and sperms are ripe and both the genitalia are ripe at the same time. This suggests the possibility of self-fertilization, for I note that isolated individuals can breed for a long period of four months and of the mating individuals, the functional male also lays eggs soon after mating, though it does not show signs of having received sperms from another individual prior to laying eggs. This problem needs a thorough investigation probably from a cytological standpoint.

The fact that isolated individuals can lay considerable number of eggs for a long period would show that the ova get fertilised batch after batch. And as the stock of germ cells gets exhausted there is a decline in the number of eggs laid. But the significance of the interesting features shown elsewhere about the fecundity is not known. Sometimes I find that the number of eggs laid by an individual having come very low, suddenly rises up.

Sedgwick mentions of cases of *Limnææ* that have been kept isolated for life and that have laid eggs. These, he says, might be cases of parthenogenesis. But there is no parthenogenesis in the species I have been observing.

Another interesting feature of breeding of *Limnææ* has been noticed. The fecundity seems to be susceptible to environmental influences. Though I am not in a position to give detailed statistics at present to show the relation between fecundity and environment, yet sufficient evidence is available for me to state that environmental variations do affect the breeding of *Limnæa luteola*.

For a month a number of individuals were kept isolated in separate jars. The water was not changed and the food which consisted of leaves of *Vallisneria* was not renewed. Many of these individuals had been laying eggs regularly but under the changed conditions the breeding ceased abruptly. Again a number of individuals were kept crowded for about a week without food. The number of eggs laid was very low. But the same individuals after being placed in fresh water with a fresh supply of leaves, began laying eggs regularly. This was observed on many occasions. It is worth finding out what exactly is the connection between fecundity and nutrition here.

In fine the breeding habits of *Limnæa luteola* present many problems of interest which need elucidation. The regular rise and fall of the number of eggs laid, the capacity of isolated individuals to breed for a prolonged period, the phenomenon of both the mating individuals laying eggs soon after mating, though mating is not reciprocal, the influence of environmental changes on breeding,—these are some of the problems that require explanation. It is also necessary to find out where in the genitalia, and how, when, and how often, the fertilization of ova takes place.

NOTE ON THE STATEMENTS AND GRAPHS APPENDED TO THIS ARTICLE.

Statement A, Page 160

This statement shows the variation in the number of eggs in the successive batches laid by an individual.

Statement B, Page 162

This shows the total number of eggs in the batches recorded and the average per individual per batch.

Statement C, Page 162(A)

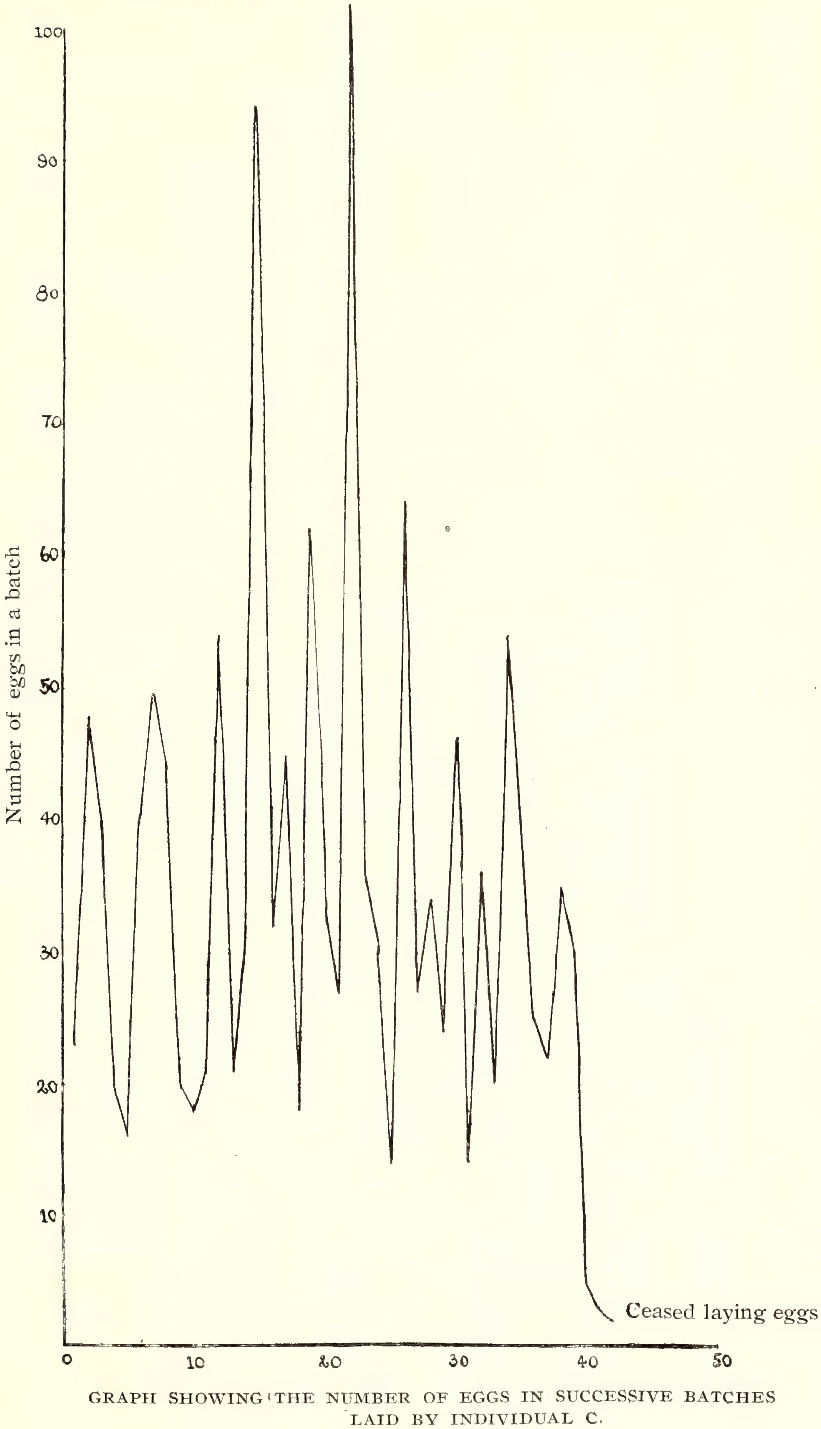
This shows the frequency with which eggs are laid.

Graph I

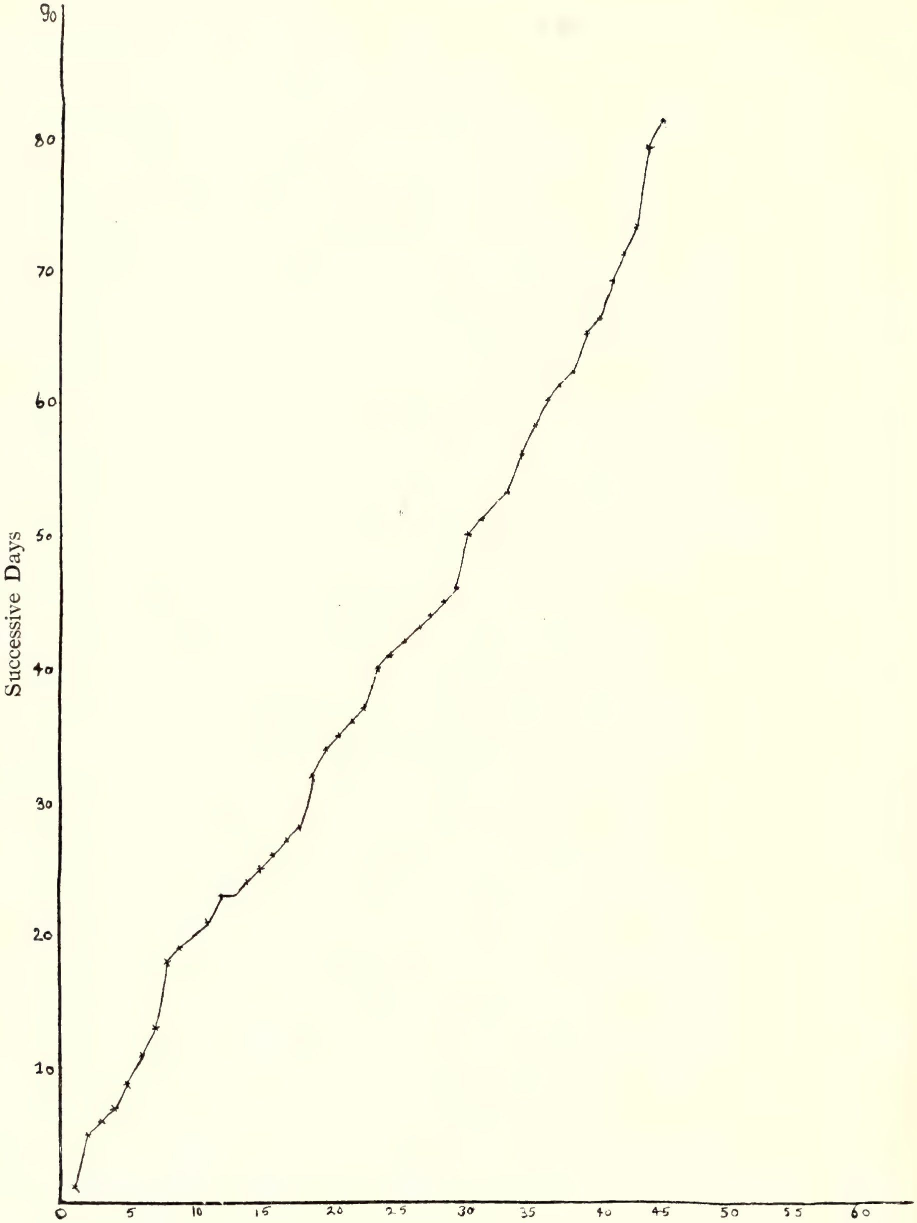
This graph shows the variation in the number of eggs in successive batches laid by an individual. It will be seen that after rising high the number of eggs per batch comes low and after one to three batches rises again. Then it comes low and so on.

Graph II

This graph will give an idea of the frequency with which the eggs are laid. It will be seen that eggs are laid successively for two to four days and then there is a break after which eggs are again laid regularly.



GRAPH SHOWING THE NUMBER OF EGGS IN SUCCESSIVE BATCHES LAID BY INDIVIDUAL C.



GRAPH SHOWING THE FREQUENCY OF EGG LAYING BY INDIVIDUAL C.

A. STATEMENT SHOWING THE NUMBER OF EGGS IN SUCCESSIVE BATCHES LAID BY A NUMBER OF INDIVIDUALS

Number of Batch	Name of Individual																			Remarks
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	36	39	23	43	54	40	33	25	45	24	39	29	54	63	35	35	54	55	44	batches of eggs, but only those whose record of eggs was for the individual per year which is likely to be greater.
2	60	54	48	40	84	72	10	7	40	35	69	64	34	39	81	105	55	60	16	
3	35	39	40	39	12	9	13	16	18	11	60	51	20	97	27	60	40	28	8	
4	31	20	20	39	31	34	34	57	32	24	54	72	42	26	9	48	54	78	10	
5	24	60	16	54	39	38	20	5	7	4	60	36	32	80	8	36	39	85	34	
6	16	39	40	29	29	20	66	44	35	25	27	29	30	40	7	24	9	72	34	
7	52	40	50	39	63	11	19	12	28	15	63	27	30	20	14	13	11	20	16	
8	21	29	44	39	51	26	18	27	18	12	36	18	19	59	26	64	22	34	15	
9	14	51	20	33	32	18	20	18	15	22	36	42	42	39	18	39	9	29	24	
10	63	33	18	34	29	4	19	15	10	18	99	40	27	16	32	39	24	42	32	
11	45	21	21	28	98	16	16	20	58	9	24	19	14	29	27	36	9	72	99	
12	34	35	54	34	53	14	13	9	27	7	94	39	24	59	18	32	8	44	60	
13	48	52	21	...	28	...	4	6	26	6	128	19	33	60	5	45	42	42	45	
14	20	28	31	...	74	...	4	8	8	16	102	24	11	33	4	19	24	64	30	
15	54	29	94	...	14	...	...	18	18	11	140	63	42	30	34	24	14	12	49	
16	22	6	32	...	24	...	...	34	11	20	94	27	32	20	34	64	12	18	27	
17	16	21	45	...	14	...	...	12	9	...	34	14	19	18	...	30	34	...	45	
18	35	30	18	...	34	...	...	37	28	...	24	54	10	29	...	36	10	...	69	
19	15	42	62	...	...	...	...	8	12	...	21	59	18	37	...	30	...	...	48	
20	65	25	35	...	...	...	...	22	10	...	29	14	6	25	...	11	...	...	56	
21	7	39	27	...	...	...	...	15	14	...	14	34	24	9	...	32	...	...	24	
22	19	16	102	...	...	...	...	9	17	...	13	45	32	60	...	14	...	...	39	
23	34	23	36	...	...	...	...	2	...	...	25	34	26	34	...	...	...	...	28	
24	19	29	30	...	...	...	...	...	...	...	7	28	25	102	...	...	...	...	43	
25	34	19	14	...	...	...	...	...	...	...	24	6	34	54	...	...	...	...	34	
26	4	34	64	...	...	...	...	...	...	...	30	...	...	14	...	...	...	...	26	
27	36	...	27	...	...	...	...	...	...	...	20	...	...	26	...	...	...	...	...	
28	13	...	34	...	...	...	...	...	...	...	95	...	...	56	...	...	...	...	...	
29	...	...	24	...	...	...	...	...	...	...	15	...	...	8	...	...	...	...	...	

30	...	...	46	...	...	...	...	...	...	...	19	...	...	...	...	...	...	...	...
31	...	...	14	...	...	...	...	...	...	...	22	...	...	...	...	...	...	...	...
32	...	...	36	...	...	...	...	...	...	...	30	...	...	...	...	...	...	...	...
33	...	...	20	...	...	...	...	...	...	...	17	...	...	...	...	...	...	...	...
34	...	...	54	...	...	...	...	...	...	...	12	...	...	...	...	...	...	...	...
35	...	...	32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36	...	...	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
37	...	...	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
38	...	...	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
39	...	...	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
40	...	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
41	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
42	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Total.	872	853	1,420	451	763	302	229	426	486	59	1,576	887	680	1,182	379	836	470	755	955

As will be noted from Statement (C), these individuals have laid more maintained are noted here.
The number of batches or of eggs recorded does not represent the maximum

A. STATEMENT SHOWING THE NUMBER OF EGGS IN SUCCESSIVE BATCHES LAID BY A NUMBER OF INDIVIDUALS

Number of Batch	NAME OF INDIVIDUAL																			REMARKS
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	36	39	23	43	54	40	33	25	45	24	39	29	54	63	35	35	54	55	44	As will be noted from Statement (C), these individuals have laid more batches of eggs, but only those whose record of eggs was maintained are noted here. The number of batches or of eggs recorded does not represent the maximum for the individual per year which is likely to be greater.
2	60	54	48	40	84	72	10	7	40	35	69	64	34	39	81	105	55	60	16	
3	35	39	40	39	12	9	13	16	18	11	60	51	20	97	27	60	40	28	8	
4	31	20	20	39	31	34	34	57	32	24	54	72	42	26	9	48	54	78	10	
5	24	60	16	54	39	38	20	5	7	4	60	36	32	80	8	36	39	85	34	
6	16	39	40	29	29	20	66	44	35	25	27	29	30	40	7	24	9	72	34	
7	52	40	50	39	63	11	19	12	28	15	63	27	30	20	14	13	11	20	16	
8	21	29	44	39	51	26	18	27	18	12	36	18	19	59	26	64	22	34	15	
9	14	51	20	33	32	18	20	18	15	22	36	42	42	39	18	39	9	29	24	
10	63	33	18	34	29	4	19	15	10	18	99	40	27	16	32	39	24	42	32	
11	45	21	21	28	98	16	16	20	58	9	24	19	14	29	27	36	9	72	99	
12	34	35	54	34	53	14	13	9	27	7	94	39	24	59	18	32	8	44	60	
13	48	52	21	...	28	...	4	6	26	6	128	19	33	60	5	45	42	42	45	
14	20	28	31	...	74	...	4	8	8	16	102	24	11	33	4	19	24	64	30	
15	54	29	94	...	14	...	...	18	18	11	140	63	42	30	34	24	14	12	49	
16	22	6	32	..	24	...	...	34	11	20	94	27	32	20	34	64	12	18	27	
17	16	21	45	...	14	...	...	12	9	...	34	14	19	18	...	30	34	...	45	
18	35	30	18	...	34	...	...	37	28	...	24	54	10	29	...	36	10	...	69	
19	15	42	62	...	...	...	...	8	12	...	21	59	18	37	...	30	...	...	48	
20	65	25	35	...	...	...	...	22	10	..	29	14	6	25	...	11	...	...	56	
21	7	39	27	...	...	...	...	15	14	...	14	34	24	9	...	32	...	...	24	
22	19	16	102	...	...	...	...	9	17	...	13	45	32	60	...	14	...	...	39	
23	34	23	36	..	...	...	..	2	...	...	25	34	26	34	...	...	...	...	28	
24	19	29	30	...	...	...	...	..	...	...	7	28	25	102	...	...	...	...	43	
25	34	19	14	...	...	...	...	..	...	...	24	6	34	54	...	...	...	...	34	
26	4	34	64	...	...	...	...	...	...	...	30	...	...	14	...	...	...	...	26	
27	36	...	27	...	...	...	...	...	...	...	20	...	...	26	...	...	...	...	...	
28	13	...	34	...	...	...	...	...	...	...	95	...	...	56	...	...	...	...	...	
29	...	...	24	...	...	...	. .	...	...	...	15	...	...	8	.	...	...	...	...	
30	...	...	46	...	...	...	...	...	...	...	19	...	...	...	...	...	...	...	...	
31	...	...	14	...	...	...	...	...	...	.	22	...	...	...	...	...	...	...	...	
32	...	...	36	...	...	...	...	...	..	...	30	...	...	..	...	...	...	...	...	
33	...	. .	20	...	...	...	...	...	...	...	17	...	...	...	...	..	...	..	...	
34	...	...	54	...	...	...	...	...	...	...	12	...	...	...	...	...	...	...	...	
35	..	...	32	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	
36	...	...	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
37	...	...	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
38	...	...	35	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	
39	..	...	30	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	
40	...	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
41	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
42	...	...	2	...	...	...	...	.	-	...	...	..	...	...	...	...	...	...	...	
43	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
Total.	872	853	1,420	451	763	302	229	426	486	59	1,576	887	680	1,182	379	836	470	755	955	

B. STATEMENT SHOWING THE TOTAL NUMBER OF EGGS AND BATCHES RECORDED AND THE AVERAGE PER INDIVIDUAL PER BATCH

Name of Individual	Number of batches recorded	Total number of eggs	Number of eggs per batch
A	28	872	31
B	26	853	33
C	42	1,420	34
D	12	451	38
E	18	763	42
F	12	302	25
G	14	229	16
H	23	426	19
I	22	486	22
J	16	259	16
K	34	1,576	46
L	25	887	35
M	25	680	27
N	28	1,182	42
O	16	379	25
P	22	836	38
Q	18	470	26
R	16	755	47
S	26	955	37

Average per Individual per batch = 32.

73	74	75	76	77	78	79	80	81
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
1	...	..	...	...	...	1	...	1
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
1	...	...	...	...	...	1	1	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	..	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

C. STATEMENT SHOWING THE FREQUENCY OF LAYING SUCCESSIVE BATCHES OF EGGS BY DIFFERENT INDIVIDUALS

	Successive Days																																																																																		Total Number of Batches	No of Days	Average frequency
—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83			
A	1	..	1	...	.	1	...			.		1	.	.		1		1	...		1	.	1	1	...	1		1	1	1	1			1	.		...	1	...	1	1	1	...	1	...	1	...	1	...	1	...	...	...	1	...	1	...	...	...	1	...	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	67	2
B	1	1	...	1	...	1	...	1		1			1	...				...	1		...	1		1	...		1	1				1		1	...	...	...	...	1	1	...	1	...	1	...	1	1	...	1	1	...	1	...	1	1	...	1	...	1	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.	31	65	2
C	1	..	...	...	1	1	1		1		1		1			1		1	1	1	1	.	1+1	1	1	1	1	1		..		1		1	1	1	1	...	...	1	1	1	1	1	1	1	...	...	...	1	1	1	1	...	...	1	...	1	...	1	1	1	...	...	1	1	...	...	1	...	1	...	1	...	..	...	...	...	1	..	1			47	83	2
D	1	..	...	...	...	1	1			1	.					1		1	...	1	..	.	1	1	...			1		1					1	1	...	1	1	1	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.	18	51	3
E	1	.	...	...	...			1			1					1		...	1	1	...	.	1	..	1			1	1		1	1		1									.		1+1	1	1			1					1	.														.									.					20	55	3
F	.	...	...	...	...	1			1	1	1	...	1	1	.	1	.	1	1	1	...	.		..	...	.								.											..																			.					..															12	30	3
G	1	..	...	...	1	1			...	.	1	1	1					...	1		...	...	1	1	...	1	1	1	.	1					.											.																					..										..							14	[illegible]	2
H	1	1	...	1	..	1			1	1			1			.	.	1	...		1	1	1		...		1		1		1	1	1	1	1		1	1	1	1			.		..	..			...				.																							.								23	40	2
I	.		1	1	1			1	1		.	1		1		1		...	..	.	...	1	.	1	1	1		1		1			1		1		1	1	1	1				.		.							..								.												.											22	46	2
J	1			1	1			1		1			.				1	1	...		1	1			1	1						.	1		1	1								.		..																																						16	[illegible]	-
K	.			...		.			1	.		1		1			.	...	1	1	...	.	..		1	1	1			1		1		1						1				1			.	1	1			1		1	.	.	1		1			.	1		1	1		1	.	1		1	1				.		1	1				34	80	2
L	1	.				.	..	1	1	1	1	.		.		1		1	..	.	1	...	1			...	..	...	1	1		1	1	1	1	.	1	1		1	1	.	.		1		.	.	1	1	1				1	1	1	1	1		.																					.		29	59	2
M	1	.	1		1			1	1		1	1	..			1		1		1	1	1		1			1	1	1	1		1		1		1	1	.	1	.	1	1	1				1	...			.				.									.					..		.						.				..			29	47	2
N	1			1	1		.	.	.	.		1		.	.	1			1	1		1	1	1	.		.		1	1			1	1	1	1	1	1		1	1	.	1	1	1	.	1		1		1		1				1			1	1			1		...		.				...								.	..			33	64	2
O	.	...		..		1	1		1	1			.	.		1		1		1	...	...				.		1		1			1	.	1		1	1		1					1	1	1			1	.	1	.	.								..		..			.		..			.	.				.		.	.			...	19	52	3
P	1	..		...	..			1	1		1		1		1		1	1	..	1	1	...	1	1	.	...			.	1		1	1	1	..	1	...	..		1				1		.	1	1	1	1			.		1			.					.						.	..		..		.			.				..	.		24	55	2
Q	1	...		1			.		.		1	.	1	1	1		.	1	1	.	1	...	...		1	..	1		1	.	1	1			1	..		1	.				1	1	1	1	.			1			1	.	..		.			.					...			...	.	.	.	.	...	..		..	...		.	...	.		.	22	53	2
R	1		...	.		1	1	.	1	.	1		1	.	1	.	1		1		.	.	1		..	...		.	1	..	1		1				1					1	1		..			1	1	.							.			.					..				.			...						.		.			..	21	50	2
S	1	.		...	...	...	1	1+1	1		1	1	1	1	1	1		.	...		...	...	1	..	1	1	1	1	1	1	1	1		1		.	..	1	..	.	1			.	.	1			1	.	1	1		1	1		.									..			..	.	.	.	..		.	.	..			.	.		..	30	55	2

A JOURNEY ACROSS THE HIMALAYAS

BY

J. W. Borradaile

(With four plates)

Looking northwards from Simla, the great Himalayan chain appears to form an unbroken barrier, yet at this point it is crossed by one of its oldest caravan routes, one branch of which goes to Tibet; the other passes through Kulu, Lahoul and Ladak. In order to save time on my journey to Lahoul, I did not take the road from Simla, but motored from Pathankot through the beautiful Kangra Valley, and after crossing the Bubbu Pass over the outer Himalayas, I descended through a forest of huge pines and joined the road in the valley of Kulu.

Kulu is the basin of the River Beas. It has a wide cultivated area overhung by giant forests, above which in a complete ring can be seen the snows of the Central Himalayas. It can be reached at any time of the year and it is famous for its orchards. Kulu Valley is soon to be opened up by a first class road and then the difficulties of reaching it during the winter will be at an end.

There are always traders' camps on the banks of the Beas and an inspection of their wares is interesting. Travelling in the valley is very comfortable as the road is good and there are dâk bungalows at each stage.

Kulu can be reached in six days from Pathankot by ordinary stages. Cost of motor is Rs. 20 per seat; mules Rs. 1-4-0 per stage; coolies have tehsil rates according to the length of the march, approximating at 8 as. with a bonus for the high passes. Eggs and chickens are large and cheap. The trout fishing is excellent though, early in the year, it is spoilt by the snow water. In addition there is pheasant and woodcock shooting during the winter, also red and black bear. Unfortunately the number of licences issued each year is very limited, so the Forest Officer should be applied to early.

After four days I reached the foot of the Rohtung Pass, and although I had intended to camp some way up, I was compelled to spend the night at Rahla rest house, on account of the heavy rain, and this caused me many difficulties on the following day.

The Rohtung Pass is only 13,500 feet above sea level, but it is famous for its daily hurricane, which starts at nine every morning. I had engaged two mules at the start of my journey and had since got a third with which to cross the pass. Owing to a late fall of snow, the pass, though easy for foot traffic, was very difficult for mules, which do not take to the snow nearly so well as the little Yarkhandi and Spiti ponies.

In spite of repeated warnings that I should be over the pass before sunrise, a start was not made until 4 a.m. The summit was gained without any difficulty about an hour after dawn, and it seemed as if the passage would be a very easy one.

Looking over into Lahoul from the Rohtung Pass is like entering a new world. Gone are the forests and cultivation, and in their place, as far as the eye can see in every direction are peaks and glaciers without so much as a blade of grass.

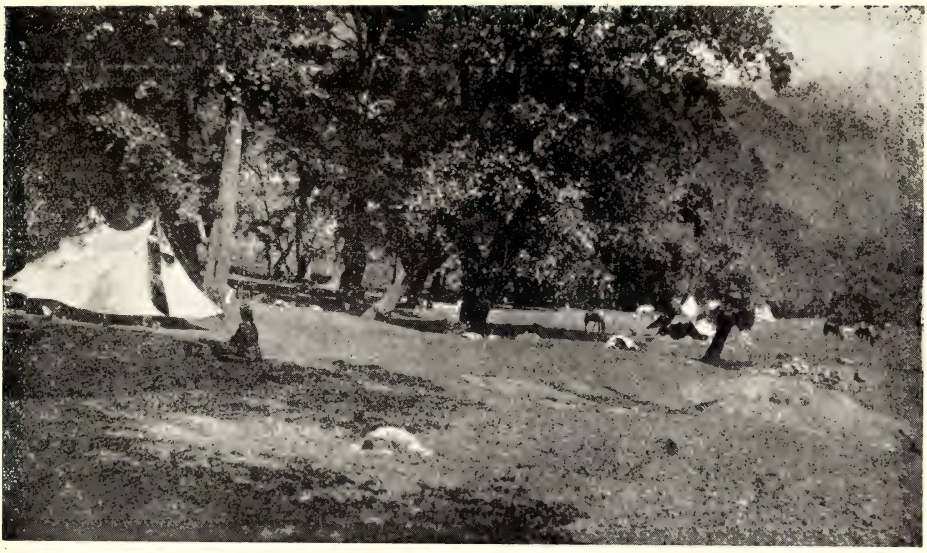
It was on the far side of the summit, that we met a man from the Lahoul side, who told us that there were three miles of snow in front of us, which were impassable for mules. Very soon after this the thaw started, and the mules began to flounder. However, by unloading them and dragging the baggage along the snow, we managed to force them on some way. But at last the animals became quite exhausted, and their knees were bleeding from repeated falls, so that we could neither move them towards Lahoul nor back towards Kulu. Moreover, the daily hurricane had just started. Accordingly we made for a refuge hut which had been built after a disaster some years ago, for travellers caught by a blizzard.

We found that this hut was packed with ice, so I decided to make for Koksar, the first village of Lahoul and get assistance. I only succeeded in producing four coolies, and returned to the top of the pass with these, to find that the foolish mule drivers had tried to continue the journey on their own, and could now neither get down the pass nor could they regain the refuge hut. The coolies took some of the baggage down and left some food for the mules and we did not get back to Koksar until after dark. There I was glad to get a meal, having eaten nothing since the previous evening except a chapatti and a cup of green tea, which a trader had kindly prepared for me during my first visit to Koksar.

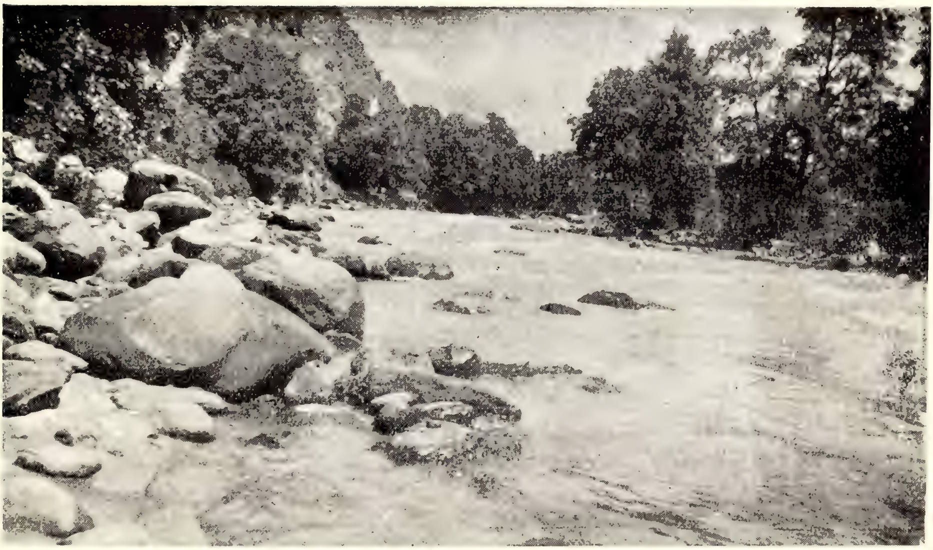
At midnight I started up the pass again, having been assured by the headman at Koksar that he would send the coolies up after me. I managed to lose my way in the dark and did not reach the mules until daybreak. Needless to say, only two of the coolies arrived and it took us eight hours to get off the pass. This was at last achieved by tobogganing down the snow on the baggage and leading the mules down unloaded. At last, after crossing two difficult ice bridges, we reached Koksar.

We now had four very pleasant days along a rock road to Kyelang, the capital of Lahoul. The first of these I travelled with a Buddhist lama, with whom I conversed in broken Urdu. He was preceded by a woman, who carried a trident with which to drive away the devils. When we parted my lama gave me a turquoise ring with his blessing. On the third day we reached Gondla opposite a colossal precipice, which is said to rise 11,000 feet sheer above the bed of the river, with two glaciers at the top, portions of which are constantly breaking away and descending with a roar into the valley below.

It had been my intention to cross from Lahoul into Chamba by the Kukti Pass, which although 17,400 feet above sea level was five days shorter than any of the other routes. At Gondla I heard such discouraging stories about the state of this pass, that it seemed as if I would have to give up the idea. However, I determined to make further enquiries on my arrival at Kyelang ; and so, having crossed an easy 14,000 feet pass, from which I got a marvellous view of the Spiti mountains, I met my mules, which had been sent round by

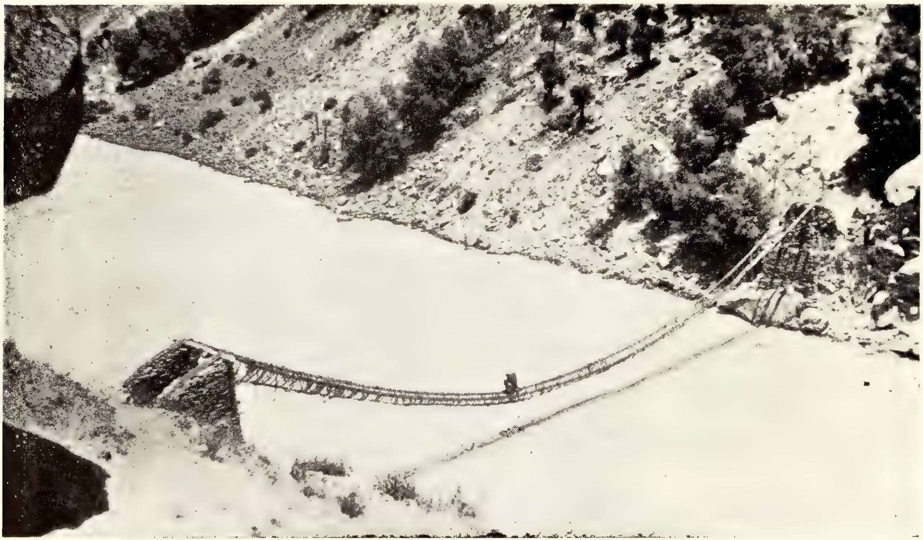


1. NOMAD CAMPS ON BANKS OF BEAS, KULU.



2. THE RIVER BEAS BETWEEN SULTANPUR AND KATRAIN, KULU.

3. VALLEY OF THE CHENAB ON THE WAY TO KYELANG, NEAR SISSUE, OVER 10,000 FT. ABOVE SEA LEVEL.



4. BRIDGE OF TWIGS (*Jhoola*) OVER THE CHENAB AT GOHBRUNG, LAHOUL. MY BEDDING IS SEEN CROSSING.

road to that metropolis. Here I met Thakar Abai Chand, Wazir of Lahoul, to whose kind assistance I owed the comfort of my return journey.

About 1,000 feet above Kyelang is the Sher-Shah monastery, which is the centre of Lahoul Buddhism, there being an exceptionally holy hill on the opposite side of the valley, a circuit of which is said to be an act of great merit. The only other monastery in the country is placed in the face of a cliff at Koksar. The great event of the year at the Sher-Shah monastery is the devil dance, which was due to take place two weeks after the day of my arrival. This festival is very interesting, as all the inhabitants from the surrounding country are present.

Lahoul Buddhism is somewhat influenced by Hindu beliefs, which is not surprising as many pilgrims pass through the country every year on the way to Trilognath, a notable Hindu centre in Chamba territory. There are still devil worshippers in the country.

In the winter 1924–1925 there was a certain amount of discord between the lamas and the laity ; this was partly due to a particularly holy incarnation, who was resident in the valley at that time and who behaved in a manner not at all in accordance with his calling. It is even said that the chief lama of a distant monastery, upon his death bed, named as his own incarnation an unborn child, rather than have this man as his successor. As a result of this friction the lamas had lost much of their influence.

Another notable feature in the country are the Chummoos or nuns, who wear red gowns and have close cropped hair. They work in the fields during the summer months and only return to the monasteries during the winter. Two of these were employed by me as porters during my return journey ; they were remarkably strong and very cheerful lasses. As a whole the women of Lahoul are of very powerful physique and walk with a long, easy, graceful stride. The lay women wear a peculiar silver ornament on their heads. The Lahouls are polyandrous and their women have considerable influence in the household.

The men are of comparatively smaller physical development, but the whole population are of Mongolian type and remarkably hardy, their chief affliction being cataract, which is probably due to snow blindness. Lahoul is completely cut off from the world during the winter months, in fact very little movement takes place in the valley itself at that time. The chief transport animal is the zho, a cross between a yak and a cow.

I now decided to visit Patseo and the Baralarcha Pass. Patseo lies some fifteen miles beyond the last human habitation in the valley of Lahoul, at an altitude of 12,000 feet. Each year the traders from Central Asia and Tibet meet the traders from India at this place, which is the lowest point to which the Tibetans, in their great fear of Indian heat, can be induced to carry their wares.

The fair at Patseo had not yet started owing to the state of the Baralarcha Pass, upon which a large caravan was then snowed up, and many ponies had died. However a great mixture of people had already arrived, including many representatives of that fine race of mountaineers the Gaddis, with their kilt-like smocks wound round with a great length of rope and their great mushroom-like pugarees.

Beyond Patseo is the serai of Zing-Zing-bar from which the pass is crossed. After a long ascent over the snow-clad slopes and past the Suraj Dal Lake, noted for its weird beauty, the top is reached 16,000 feet above sea level.

Crossing the pass opens another new world, one of utter desolation. Even the 20,000 feet mountains are dwarfed by the tremendous mean altitude. There to the north, beyond the famous grazing grounds of the Lingti Plain, lies the road to Leh, and somewhere in the wilderness of snow to the west is Togpo Gogma, the first serai on the road to Spiti. Zasker can be reached by turning off at Darcha some fifteen miles on the Lahoul side of the pass.

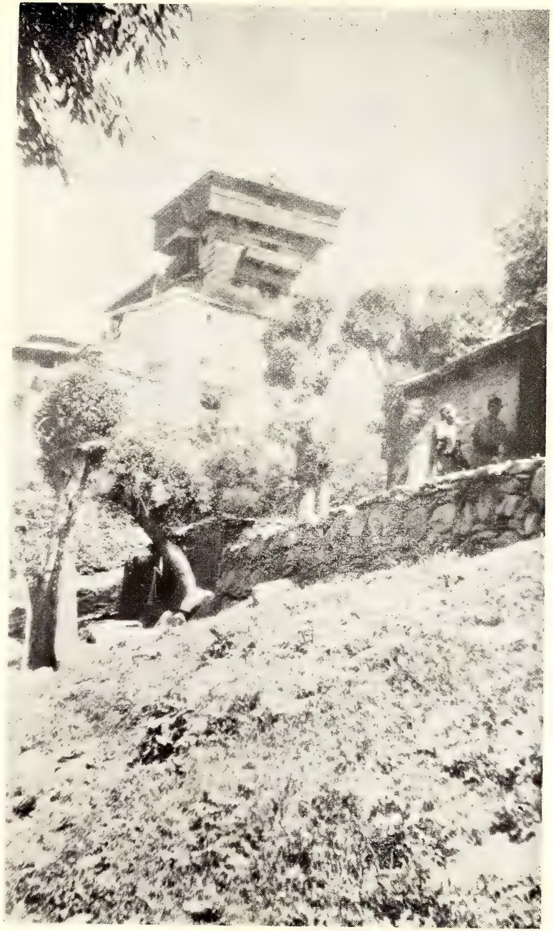
To proceed in any direction over the Baralarcha (' cross road ') Pass it is necessary to have a special permit. These are not difficult to get, but the expenses of travelling will be very great, as everything necessary for the journey must be taken from Lahoul, the country on all sides being devoid of life and vegetation. Spiti can also be reached by two other routes. The ruler of the country is called the Nono. He lives at Dankar. Bhurral can be shot in Spiti, *Ovis ammon* and bhurral in Ladak, ibex in Lahoul, though the average heads are much smaller than the Kashmir variety.

On my return to Kyelang, I got news that the Kukti Pass was now open and that the annual migration of flocks had begun. Each year vast herds are driven over the passes to the wonderful grazing grounds of the high Himalayas, returning again in the winter to the warmer valleys of the foothills.

I had made arrangements to go up the Billing Nullah, where I had hoped to shoot an ibex before returning, when I sprained my ankle, and was detained by this for the rest of my stay in Lahoul. My servant was fortunately a good masseur, and I was soon fit to travel with the aid of a tight bandage. By this time the monsoon had broken and as I feared the loosening of the boulders would prevent my reaching Chamba, I determined to set out at once.

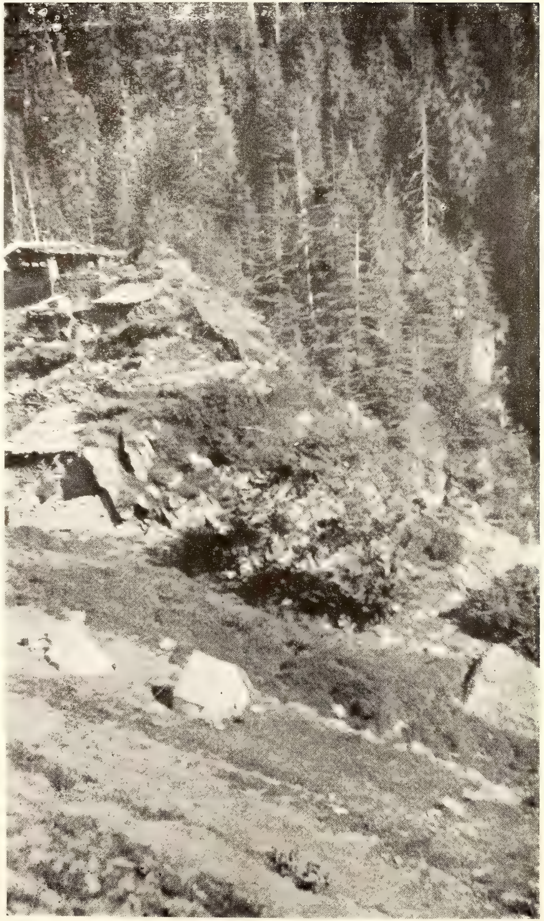
As the road was impassable for anything else, I engaged foot coolies half of whom were men and the other half women, including the two nuns already mentioned. After a Sunday morning service, conducted in Tibetan, by Mr. Peters, the Moravian missionary, I followed the coolies along the beautiful banks of the Chenab, which were covered with wild roses, bluebells and other English flowers, and on the second day I reached the bridge of twigs at Johbrung.

This bridge consisted of three ropes of interlaced twigs, to cross which you walked on the centre one and held the other two with your hands. Toward mid-stream the hand ropes got so far apart and so low that it necessitated a sort of tight rope performance to get along at all. Also the whole bridge was swinging and if you looked down at the torrent below, severe sea sickness was the result. A good yard from the end the foot rope stopped altogether and a long stride had to be made from an insecure footing to reach *terra firma*. After I had crossed with three of the men, I got news that the women had laid down the baggage on the opposite side



5. OLD CASTLE OF THE THAKARS OF LAHOUL, GONDLA.

6. MT. GARPANG (19,900 FT.) FROM SISSUE. VISIBLE FROM SIMLA ON A CLEAR DAY.



7. MY CAMP AT KUKTI, CHAMBA STATE

8. MOUNTAINS OF PIR PANJAL RANGE OVERLOOKING CHENAB, WITH GLACIER OF MT. SHIKAR BEH. 20,340 FT.

and refused to go further down. So it was necessary to get recruits from Johbrung, and even when all the baggage was across the women refused to come for their money, which had to be sent back to them.

The next day with a new train, which included the headman of Johbrung, I started the ascent of the pass. We only covered six miles on this day, camping low so as to be clear of the avalanches. On the following day we had to remain in camp owing to a storm on the pass above us. Mindful of lessons learnt on the Rohtung Pass, I started at midnight. This caused much pain and sorrow to the coolies, as the going was not nearly so good as on the other pass.

Presently we reached the snow line, and ascended a steep tongue of snow in two parties. Those in front would shout *Om mani padmi hom*, at about every hundred yards and this was re-echoed by the party behind, to be taken up again at regular intervals. As we neared the top, the ascent became steeper, and as a late fall of snow had covered the ice, it was very hard to get a decent foothold. Fortunately I was wearing the grass shoes of the country, and I believe that I could never have proceeded in ammunition boots. We were relieved to reach rock again as we could cross this at a better speed. The headman and I, who were leading were busy cutting steps across the ice at the top, when the first coolie disturbed a large boulder which came bouncing down on the top of the rest, like an overgrown football. I have never seen men take cover so quickly, but a shepherd who was with us moved just too late and had his shoulder smashed. The only woman coolie lost her footing and went down several hundred feet. Fortunately she fell into a snow drift, and when we got her up again she was able to continue the journey.

Now that the top was reached we called a halt, and after the shepherd had been attended to as well as possible and sent back, a sheep was sacrificed to the accompaniment of much horn blowing and bell ringing.

Soon, gathering clouds and a slight sleet warned us that we should be moving. Accordingly we began the descent to the glacier over a sheer drop of ice-covered rock. This was very slippery and we proceeded with great caution sometimes even hand in hand. Here my bearer was delighted to find some crystals. The glacier presented no difficulties as the crevasses had not yet fully opened. The danger being that once these have opened and been covered with a light fall of snow, they are invisible until trodden over. We now had an easy climb down the rest of the pass and camped at 4 p.m. in a cave well clear of the rolling boulders. The altitude of 17,400 feet had given me a severe headache and I was glad to turn in.

On the next day we reached Kukti, the first village in Chamba. In this state I had expected transport difficulties, as everything had to be arranged from the wrong end. But thanks to the kindness of H. H. the Raja, I was met by the headman of each village about a mile before reaching it and was supplied with everything I required.

From Kukti I had two very trying marches down a gorge. The track, after passing through a splendid pine forest, narrowed considerably as it crossed the face of the cliff and then, widening again crossed the Saralla Pass, and so after six days to Chamba town. The monsoon had by this time started in earnest, but after the first two marches there were always good rest houses in which to get dry after the day's march. From Chamba it is only two short marches past the beautiful valley of Kajiar to the cantonment of Dalhousie.

Chamba State suffers from a peculiar disadvantage of being divided in half during the winter months, as a snow range cuts off the whole of the northern area. All shooting and transport regulations can be had on application to the Secretary to H. H. the Raja. Of all the parties which were shooting in this state during the early part of the year, I did not hear of one which returned empty-handed. The inhabitants at Chamba are somewhat mixed in race and are strict Hindus.

The whole journey of over four hundred miles cost me just as many rupees, exclusive of stores bought at Delhi. These included a medicine chest, a very necessary item, for the inhabitants look upon every white man as a qualified doctor, and though I practised to some extent, I fear that I was a very sorry quack.

PRINCIPLES AND EXTENT OF THE EDUCATIONAL SERVICE RENDERED TO THE SCHOOLS BY MUSEUMS IN AMERICA

BY

S. H. PRATER, C.M.Z.S.

Curator, Bombay Natural History Society

(*With four plates*)

Perhaps the most impressive phase of museum activity in America is the work done by these institutions for the public schools. The Museum has become a vital factor in the educational life of the people and this ideal of service has developed and is developing so rapidly, that, with new facilities and a fuller comprehension of the scope of museum responsibility, the museums of the country will become to an even greater degree one of the leading agencies for the cultural development of the nation.

The main principle which governs the teaching service the museum offers to the schools is that this teaching should not add to the work of the school teacher, but on the contrary, should be planned to assist him in the work he actually has to do. It should not add to his burden but is intended to lighten it both by affording him such information as will simplify his task and by giving him greater facilities for conveying this information to his pupils. In short the museum's teaching service does not add to the school curriculum but conforms to it—this is the secret of its success—success which can only be achieved by the closest co-operation between the museum and the educational department. Every phase of museum instruction to be successful must be the result of experiment and discussion between the museum authorities and the schools, and the growth and development of this service, if it is to be effective, must follow the helpful suggestions of school teachers who have previously associated themselves with museum educational work.

EXTRA-MURAL SERVICE

In America the scope of the museum's service has not been confined to assisting the teacher in the museum galleries but is extended to afford him facilities for instruction in the class room. This is effected by placing at his disposal information which will be of service to him in the teaching of various subjects prescribed by the school syllabus, in the shape of lantern slides, prepared lectures, and special exhibits and also by sending museum lecturers to the schools to assist the teacher and to simplify the work he has to do.

Lantern Slides and Lectures

The lectures and the slides illustrating them cover a wide range of subjects dealing with History, Geography, Hygiene, English Literature, Domestic Science, Nature Study and High School Biology ; in brief, the subjects selected conform to the courses of study prescribed for the schools. The effectiveness of this 'visual instruction' which the museum is in a position to offer to the school can be readily recognized. We are most of us visual minded, anything that has been presented to the eye has the best chance of being retained and recalled. By putting an idea into visual form we increase its power both by the swiftness and clarity with which it is received and the ease by which it is recalled. Visual instruction, by bringing the pupils in visual, and therefore more graphic, contact with the subjects about which they are learning, helps to drive the lesson home and simplifies the task of the teacher. The object of the museum's lecture service is a means to an end—not the end. Its object is to plant the seeds of desire for knowledge, to suggest to the children many interesting things that lie about them, to give them some idea of the cities they live in, to interest them in the world without, both animate and inanimate, to plant in them ideals of good citizenship, to help them to realize what the public institutions of the city are doing for them and the duties they owe to those institutions; in fine it aims at giving the child a saner outlook and a better understanding of life, its principles and relationships.

Some idea of the magnitude of the service rendered in this manner by various museums in the country to the schools can be arrived at by a study of the figures. In New York city the lectures and slides placed at the disposal of the schools by the American Museum of Natural History reach over 50,000 children annually. In 1915 40,000 slides were issued by this museum to the public schools, while in 1926 the number rose to 726,028. The material is delivered to the schools by a fast messenger service and the American Museum maintains a fleet of 4 motor trucks and motor cycles for this purpose. At Buffalo between 1925 and 1926 a total of 113,776 slides in 3,346 sets were loaned to the public schools. The service is also extended to private schools and institutions. In Buffalo the loan service is extended to the general public. The museum maintains, in addition to a stock of slides and lectures, a set of lanterns which may be borrowed by private individuals wishing to use them. The extent of this service may be gauged from a passage in the report of the Buffalo Society of Natural Sciences which indicates that a total of 1,941,827 or nearly 2 million slides were issued by the museum to the educational Institutions and to the general public during the 7 years the department was in operation.

Lectures in the Schools

The second method of extra-mural service adopted by museums is the system by which lecturers, attached to the museum staff by the Board of Education, visit the schools during class hours and deliver a definite and systematic programne of lectures covering both school terms.

A word about the museum lecture. Dr. Fisher, Curator of Education at the American Museum of Natural History, in speaking to me about museum lectures said 'It requires a special type of lecturer to handle and interest an audience of school children as it does to handle an audience of adults. The best lecturers are born not made, others achieve the art through training and experience. Though many of our lecturers are university men, the ablest men are quite often found amongst those who have not had the advantage of a university career.'

The subject matter of the lectures, selected by the museum for delivery in the schools, is again entirely correlated with the courses prescribed by the Board of Education, for use in schools. The advantage of the system is that it affords facilities for instruction which the schools would not ordinarily have—and which a museum is well able to provide, that it enables a larger number of schools to benefit by the museum's educational work and thus permits the museum to extend largely its sphere of utility. In 1925, more than 200 schools in Cleveland were visited by the museum lecturers and the museum was thus able to be of service to more than 60,000 children. At the Field Museum, Chicago, the school extension service covered 259 schools with an attendance of 96,158 children.

Circulating Collections

The third method by which a museum can increase its utility as a medium of popular education is by sending properly prepared exhibits to schools where they become a medium of instruction.

A museum cannot perform its full mission for the welfare of school children by merely maintaining its galleries, however well they may be equipped, and inviting the school children to visit them. Whatever pains and trouble the museum authorities may be put to in their endeavours to induce the school children to visit their institution, it will generally be found, especially in the larger cities, that the number of children who actually visit the museum is small in comparison with those attending the schools. The system of circulating suitable material from their collections to aid in the teaching in the schools is therefore generally adopted by museums in America as a direct method of increasing the scope of their educational work. These circulating collections are made available to the schools day after day, month after month, thus becoming an influence in the lives of thousands to whom the museum might otherwise have been a stranger. This direct method of effectively associating the museum with the schools is in harmony with the views and desires of progressive school teachers, who realize that the method not only adds to the reality of the teaching but becomes an aid to a better understanding of the subject taught. thereby lightening the task both for the teacher and the pupil. In general the cases are designed to show the pupils examples of local animal and plant life. The exhibits are usually mounted in natural surroundings with painted or photographic backgrounds, showing the environment in which they are found. Besides natural history specimens, the circulating collections also include exhibits illustrating industrial and commercial products and the methods of their manufacture, etc. The subjects selected being products that are in daily use or observation by the child.

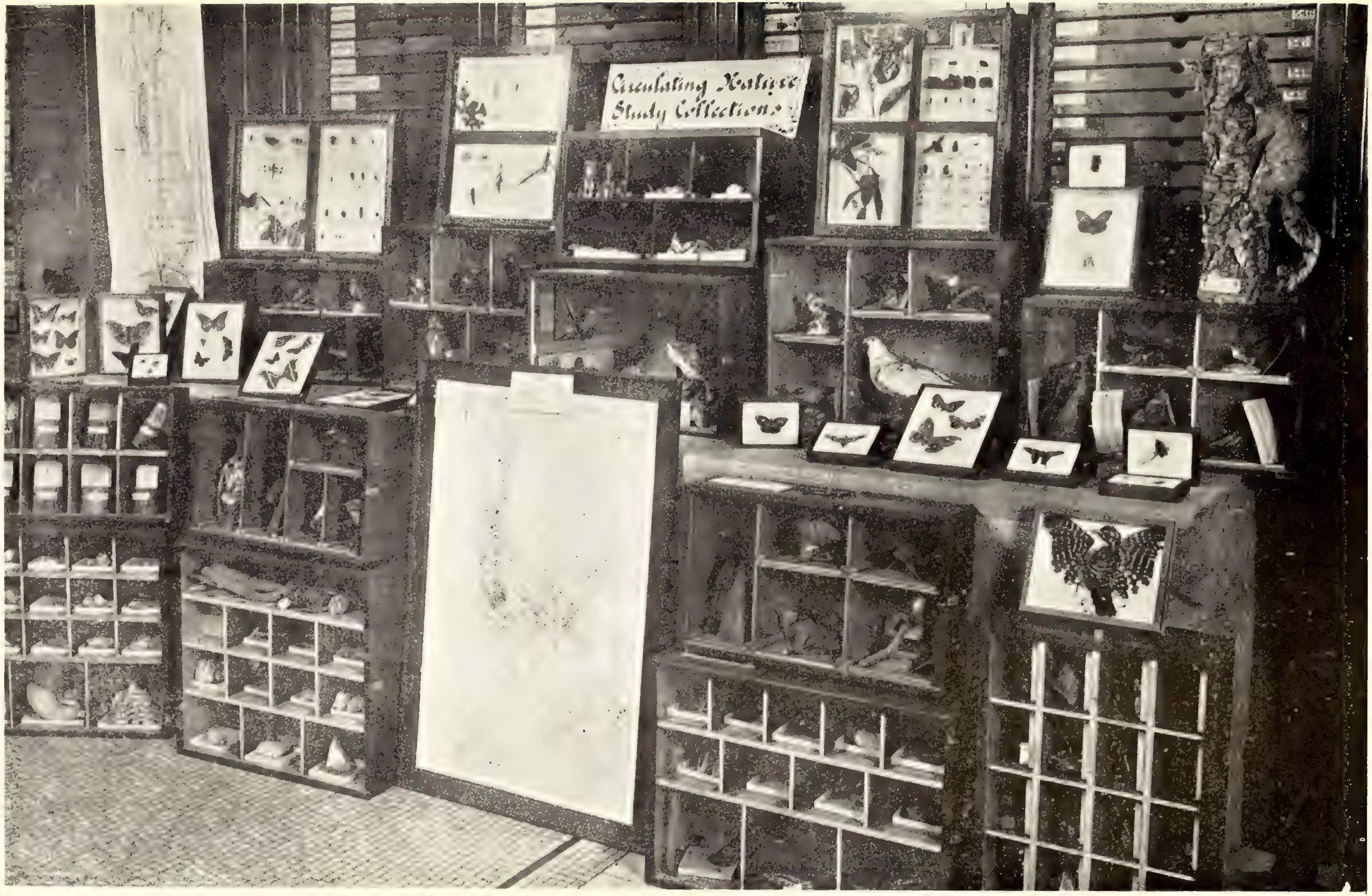
The educational value of these exhibits lies mainly in their realism. I append a series of photographs showing exhibits circulated among the schools by the Field Museum, Chicago and by the American Museum of Natural History, New York. The photos illustrate the different methods employed in the treatment of these exhibits.

In addition to the public schools these circulating collections are also loaned to various public institutions such as public libraries, art institutes, Y.M.C.A., etc. The libraries co-operate by having on hand books relative to the subject of the display. The direct influence of these exhibits is to stimulate a desire for knowledge of the subject on the part of users of the library and it results in the more extensive use of educational literature.

The report of the Field Museum, Chicago, for 1925–26, shows that the total number of cases prepared for the use of schools is 908, of this number 706 were in daily circulation and 353 schools benefited by the scheme. It is estimated that nearly ½ million pupils had the opportunity, every day of the school year, of studying two of these cases and as the cases are changed at regular intervals, thirty-six different cases were placed at the disposal of each school during the period under review. It will be seen that the system makes it possible for the museum to reach a large number of pupils than it could otherwise have reached and, besides providing pleasurable instruction, it creates a greater interest and a greater appreciation of nature; it increases the friends and frequenters of the museum and rouses in them a spirit of enquiry and a keener desire to make use of the many advantages the museum affords.

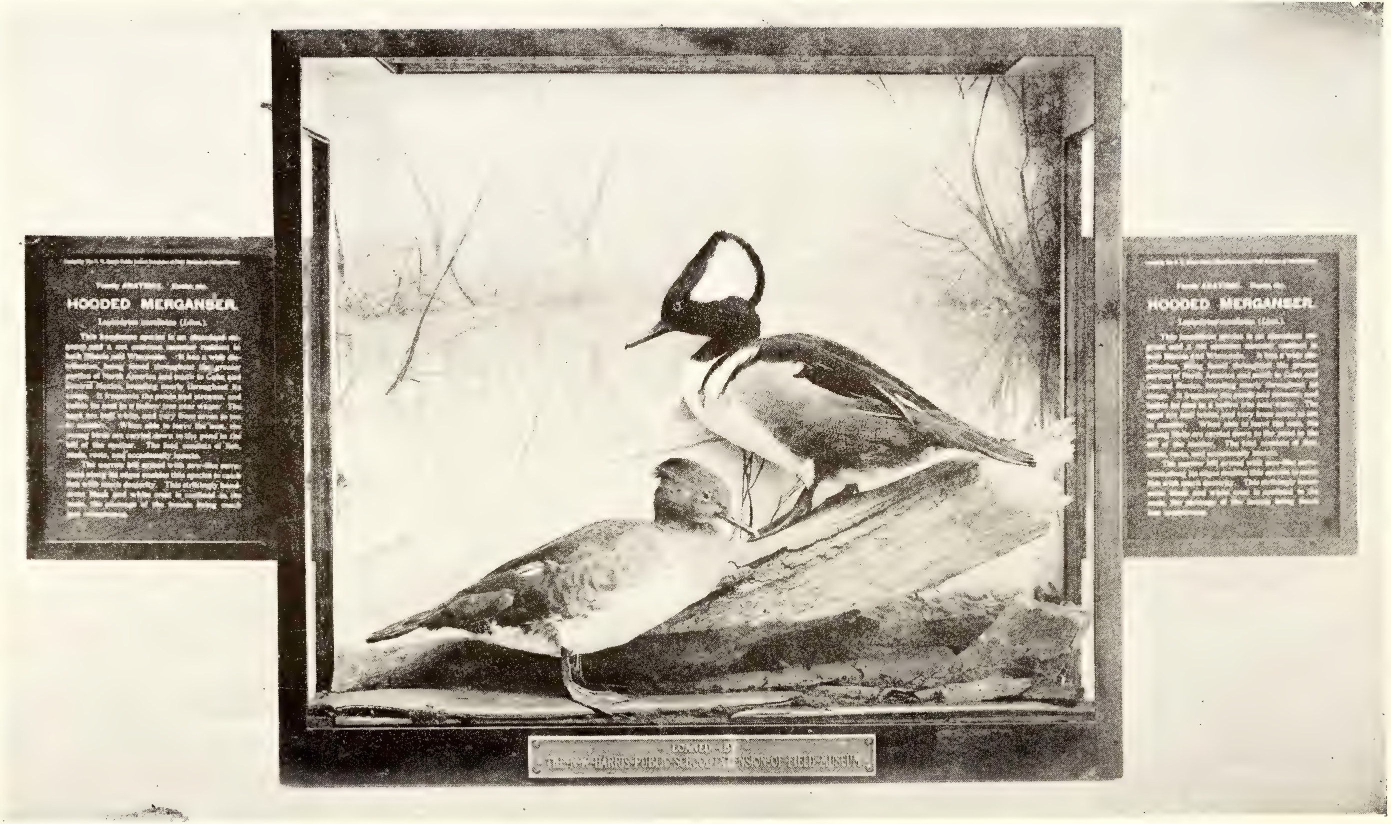
Circulating collections offer greater advantages than permanent loan collections. The latter are apt to deteriorate, and being permanent objects in a class room, the interest they occasion is apt to wane. Circulating collections are better looked after, they cover a wider field and the interest in them is constantly renewed. Damage to the specimens occasionally occurs, but no great heed is paid to this, mainly to encourage the teachers to take and make use of them.

I have tried to indicate the principles that govern the educational work carried on by the museums of America outside the walls of the museum and to give an idea of the extent and magnitude of this extra-mural service. In the great cities not everyone, and particularly the little ones, can go to the museum but the museum can go to them and by means of its stores of slides and lectures placed at the disposal of the school teacher, by its direct lecture service in the schools and by its circulating collections it can become a direct influence in the lives of thousands it might otherwise never have reached. The benefit the children derive from such a logical and intimate connection between the museum and the schools can readily be realized; its influence goes beyond the mere teaching of natural history, for every agency which directly increases the attractiveness of knowledge and the ease of acquiring it becomes an agency for national culture, for better citizenship, and for greater stability in civic conditions. And therein after all lies the secret of what we, as human beings, are after. We make life increasingly successful as we are able to minimize the time spent on certain tasks in order that our energies may be released for other worthwhile tasks and opportunities.


Circulating Nature
Study Collections

By courtesy *American Museum of Nat. Hist., New York.*

CIRCULATING NATURE STUDY COLLECTIONS.


HOODED MERGANSER
HOODED MERGANSER

By courtesy American Museum of Natural Hist., New York.

AN EXAMPLE OF A CIRCULATING COLLECTION CASE.

SERVICES WITHIN THE MUSEUM

So much for the extra-mural service of museums in America, I will now pass to a review of the principles and systems in use for carrying out educational work within the walls of the museum. The teaching offered by the museum in its galleries must follow the lines of the work it conducts directly in the schools. Here again the system demands the closest co-operation between the museum authorities and the teaching staff in the schools. We must look to the teacher for guidance both in the selection of our subject and the method of presenting it. The type of visual instruction the museum offers is comparatively new and museum instruction has not arrived at that degree of science reached in school instruction. The school instructor instructs chiefly through words, and uses pictures to illustrate his word-formed ideas. The museum teacher instructs chiefly through objects, and uses words to develop in his pupils ideas formed through a study of these objects; but all museum instructors must labour under the disadvantage of having been themselves educated mainly through verbal instruction. Till the visual instruction offered by museums, by experiment and practice, can be made to attain its fullest effect so long will it be dependent for guidance and inspiration on the methods of instruction used in the schools. It should be remembered that all educational work is largely experimental; it is useless to formulate a fixed policy, the system must be elastic and the methods employed must be discussed from time to time with people who have actual experience in education in order that a true judgment might be formed as to the measure of its effectiveness.

Teachers' Guides

One of the methods by which the exhibits in the museum galleries are brought into the service of the school teacher is revealed by the system in vogue at the Field Museum, Chicago. The Museum has prepared a leaflet which gives an outline of the public school syllabus and shows the correlation between the courses laid down for study in the schools and exhibits in the museum galleries. The leaflet covers History, Geography, Natural Science and Manual Arts. The teachers are thus made conversant with the material in the museum galleries which will directly assist in the teaching in the schools. This classification of museum material places the museum collections more effectively at the service of the schools. A teacher is able to select his subject and bring his class for instruction to the gallery where this subject is illustrated.

Museum Lectures

Apart from lectures to the pupils in the galleries, the majority of the museums provide a regular lecture hall or auditorium where a systematic programme of lectures is delivered to school children. An idea of the scope of the museum lecture service to the schools is obtainable from a study of the numbers of school children attending these lectures at the various museums.

In New York over 30,000 pupils from the local schools attend the lectures annually.

At the Cleveland Museum of Natural History in 1925–1926, 831 classes were held for schools in the museum which were attended by 27,557 children; while at the Field Museum, Chicago, 348 lectures were given last year, with an attendance of 11,821 children.

In selecting the subject matter for the lecture it is essential that the lesson should have a definite aim, the object of the lesson is not to make a scientist out of the child but it aims at instruction in 'the art of life'; at affording both food and training for the mind. This cannot be done by marshalling whole series of facts—these will soon be forgotten but the principles governing these facts will remain—the teacher must keep in mind the principle and select the best medium by which he can develop his subject and drive his lesson home. Take for example the principle that life is absolutely dependent on food. We can broaden the child's concept of this principle by showing how the structure of an animal is adapted to the conditions and manner by which it obtains its food. A lesson on adaptations in Nature is indicated. Can the subject be best taught and illustrated to children through the medium of a lecture on mammals? If so, we might develop the theme as follows:—

I. A review of the various types of vertebrate animals.

II. A discussion of the importance of food to all forms of life.

III. Grouping of mammals according to food—Carnivorous, Herbivorous, etc.

IV. Examination by the class of the teeth of each of these groups of mammals.

V. Study of the feet of these animals.

VI. Summarize the lesson and draw conclusions how these various animals are adapted to fit into their environment and to obtain the food they require.

Museum Examination Courses and Games

An important feature of the lecture is that the teacher should be able to judge its effect on the class. At the American Museum of Natural History examinations are held for the children at the museum. A series of printed questions is prepared, the answers to which are to be found not in the text books but in the exhibits and their labels in the Museum galleries.

At the Cleveland Museum the lectures are concluded by what is known as a 'Museum game.' The pupils are given a printed card of questions which bear reference to the subject matter of the lecture. A definite time is set for answering the questions at the end of which the percentage of correct answers obtained is recorded.

The museum is thus able to judge the efficiency and influence of its teaching. At Cleveland the children attending the schools are subjected to an intelligence test and the pupils in the various classes are divided accordingly i.e. an 'X' class would mean children of high intelligence, 'Y' class less intelligent and 'Z' dull children. It necessarily follows that the lectures at the museum and the games that follow must be suited to the grade of children attending them.

An 'X' class of children was given problems of its own to work out. A clever child will jump at an answer and if his mind is not given something to worry him further he will quickly lose interest. So the idea was to give them something difficult which would take sometime worrying out, to leave them at it and to keep them at work. The less intelligent children were treated quite differently, they were given simpler tasks and told to take plenty of time over them and encouraged to find out the answers themselves, made to try again and again and only helped when necessary. The success which met their own unaided efforts gave the children a new confidence in themselves and had a remarkable effect on their outlook. The value of these museum courses is that they force the child into independent enquiry for the information he or she desires. Their object is to help the pupil by permitting him to work independently and by inducing him to find out things for himself, and to the naturally curious and inquisitive mind of the child this method of instruction is both attractive and effective.

Work for the Scouts

Apart from their work with the schools the museums in America take a deep interest in the field of activity offered by the Scout organizations. At the Brooklyn Museum and at other museums a special Scout instructor is retained on the staff of the museum and a branch of the museum is generally established at the Scout training camps. The museum spirit is even carried out of doors by the establishing of what are known as 'trail museums'. A certain trail or path through a forest is treated as a museum. The trail is divided into two sections the 'training trail' and the 'testing trail'. In the 'training trail' chatty labels and classical quotations draw attention to the objects of interest to be seen on the way. The 'training trail' leads to the 'testing trail' where the labels take the form of a series of questions. The visitor walks through the 'training trail' and then answers the questions in the 'testing trail'. Contests were held by this means between different troops of scouts.

Finally the musuem helps the scout in carrying out his nature tests and obtaining his merit badges. Special demonstrations are also held at the museum for local troops. The programme of entertainment on these occasions is made up of Nature talks, motion pictures, etc., in short the museum is able to offer the scout wholesome and instructive entertainment and amusement.

Work for the Blind

The last and perhaps most sympathetic feature of Museum educational activity in America is the work done for the blind, and the crippled. One of my photographs shows a class held at the American Museum of Natural History for blind children. The method adopted is to give a lecture to the blind pupils and to illustrate it by something which they can handle, and feel. The plate illustrates special exhibits suitable for study by blind children. The specimens are arranged on trays and placed at the disposal of the class who are thus able to study and handle them. A lecture by Commander Peary, the discoverer of the North Pole, given especially for blind children, was illustrated by a raised map of the Polar region, showing the route taken by the expedition, and by the actual sleigh used on the trip which was equipped with its full complement of dogs and with its driver in Polar costume. The audience was first permitted to examine the exhibits, they then heard the lecture after which they re-examined the material with greater interest.

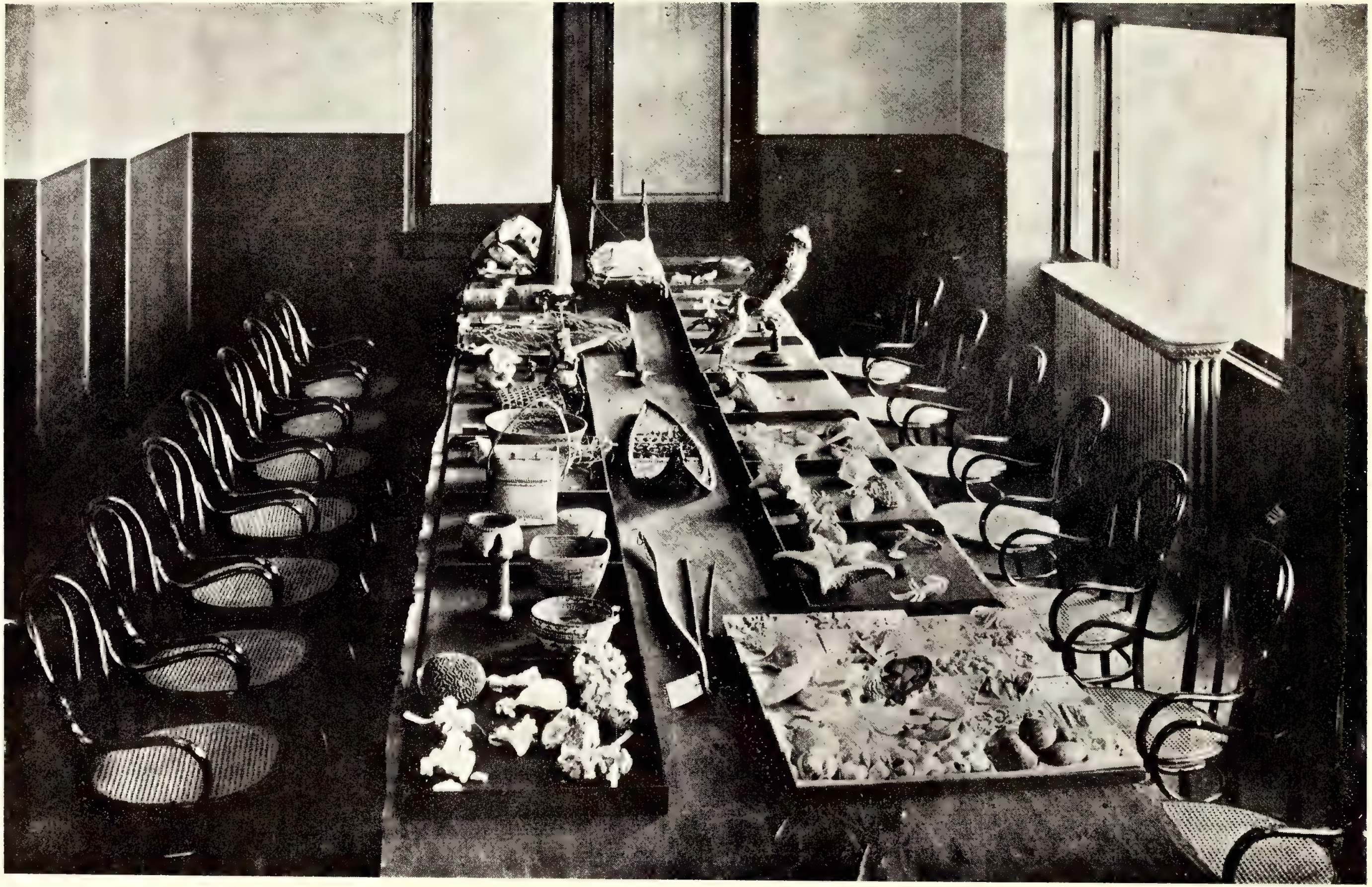
I have endeavoured to review the principles and the extent of the service rendered by museums to the cause of popular education in America. They are essentially museums for the people, seeking every channel of activity whereby their sphere of usefulness might be increased, entering into every sphere of the people's lives and working with all the resources in their power for their people's betterment and uplift. One cannot help but realize that the museum in America has developed and is developing into a great and powerful instrument for moral and spiritual development; it is to be reckoned among those great civilizing influences that are helping man to a broader understanding of life, to an appreciation of its interest and its beauty and to that conception which engenders the spirit of love to all things created. The great religons of the world are doing that, the great writers, poets and painters have done that and the museums are endeavouring to follow in their wake by an ably organized, definitely controlled and far reaching system of service to the people.

I have submitted for consideration of the committee detailed working plans showing how the various systems outlined in the above report are made to operate—unfortunately space does not permit of their being included here. I will therefore pass to the recommendations as to methods we should employ in establishing a service for the schools in our own museum.

Recommendations

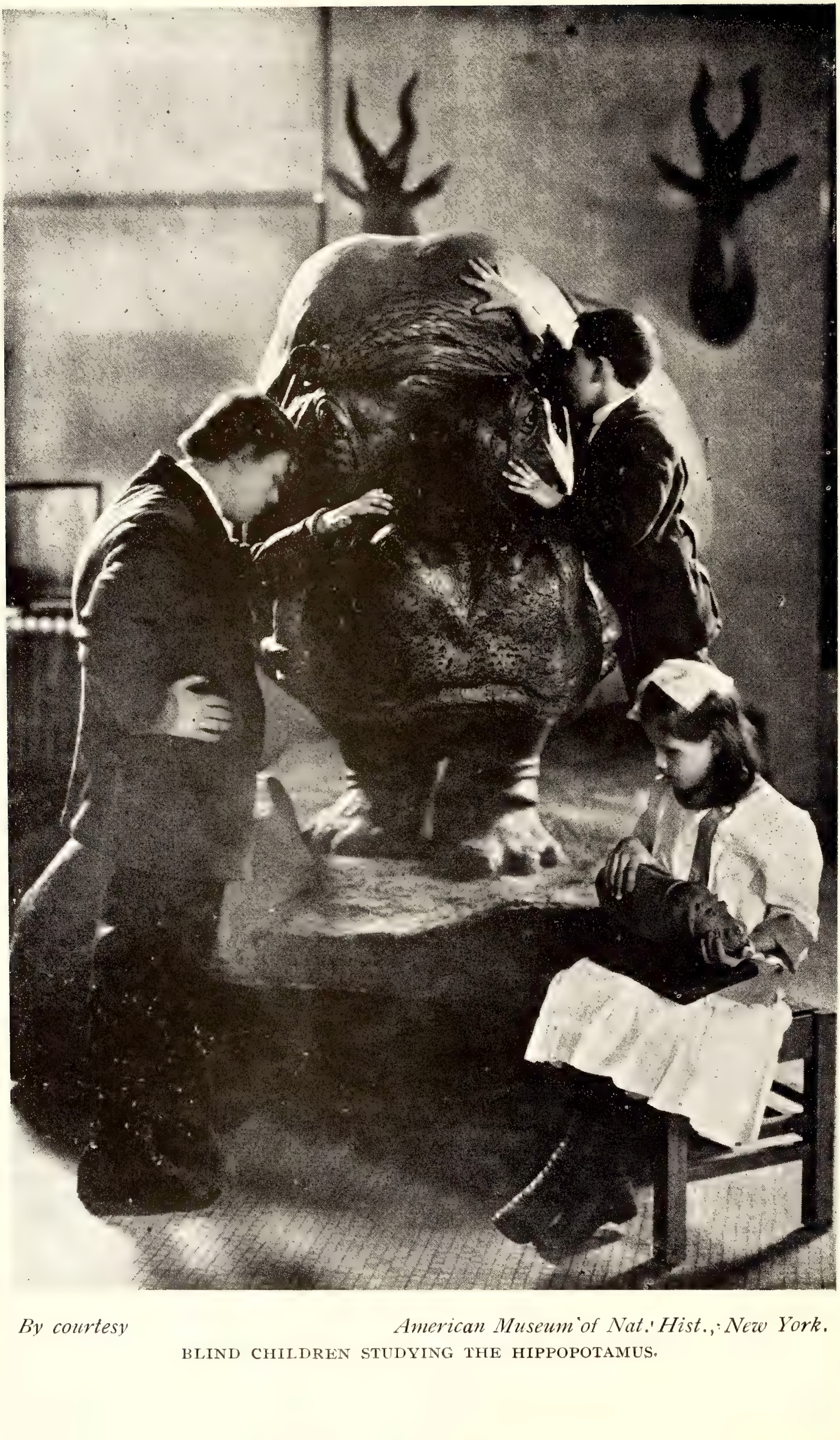
Before making my recommendations on the lines we should follow in establishing an efficient educational service it would perhaps be as well to study the methods employed by one of the museums preparatory to launching its educational programme.

The educational service rendered to the city of Cleveland by the Cleveland Museum was built up gradually. The museum authorities, having a desire to take up a programme of educational work among the schools, worked on a system which had for its policy the idea that the schools themselves should say what they required and the museum would do its best to meet them. They had to feel their way : it was no use drawing up a definite programme and forcing it upon the teachers ; such a policy, they believed, would end in failure or, at best, obtain very limited support. It is difficult to force a new system on to teachers and useless to dictate to people who have no, or perhaps very little, interest in the programme you have to offer. The first essential to success is to make the teachers understand that you are not proposing to add to their work by forcing on them new subjects but that you are out to help



By courtesy *American Museum of Natural Hist., New York.*

EXHIBITS FOR THE BLIND.



By courtesy *American Museum of Nat. Hist., New York.*

BLIND CHILDREN STUDYING THE HIPPOPOTAMUS.

them by simplifying for them the teaching of subjects they are actually engaged in.

The Curator of the Cleveland Museum first held at the museum a very informal meeting for teachers and principals of the local school at which meeting he outlined his programme and told them what he had to offer; he then asked their advice as to the methods by which he could best co-operate with them. To awaken their interest still further a preliminary lecture was given to the teachers and principals in the local schools. It was a purely informal affair which concluded in the cordial atmosphere produced by tea and light refreshments. After the lecture suggestions came from the teachers that the same lecture, in a modified form, might be given in their own schools; requests came from so many schools that the curator was no longer able to cope with the work. A special lecturer was then appointed from the regular staff of the education department to take over the work. The system grew and in a year or two they had two lecturers who visited each school in the city at least twice during each term. This led to the forming of a very definite and systematic service of lectures at the schools whereby more than 200 schools in the city were visited and the museum reached some 60,000 children. As the lectures were illustrated either with museum material or with photos of museum material, naturally a new interest in the museum was created which resulted in a desire on the part of the teachers to visit the museum and bring their classes there. This led to classes for children being held at the museum. The lecture service at the museum thus grew up normally; it was not forced and there was nothing compulsory about it. This system of classes at the museum was started in a small way, the schools telephoning for an appointment or writing; gradually a considerable proportion of the local schools commenced to avail themselves of the service the museum offered and it became necessary to draw up a regular schedule whereby four classes were held for each school during the year, i.e. two classes during each term. More schools came into the scheme till in 1925-26, 831 classes were held at the museum attended by 27,577 children. As the system grew two lecturers were appointed to the museum staff who lectured alternately to the children each giving three lectures per day. This briefly explains how the museum's school extension service was established and placed on a firm footing.

Now a consideration of the policy and methods employed by museums in America in their educational work for the schools reveals the main principle that all such service should be correlated to the courses of study prescribed for the schools by the Board of Education, that the service should not add to the burden of the school teacher but should assist him, and that the development and growth of this service is dependent on a natural desire on the part of the school teacher to make use of the opportunities and advantages the museum offers him.

The first step would be therefore to consider, by a study of the syllabus prescribed by the Education Department for the use of Primary and Secondary schools, the ways and means by which the teaching service the museum proposes to offer can be correlated with and be made to conform to the courses of study laid down by the department.

The points for consideration would be whether the different sections of the museum can obtain and supply information that would be directly helpful to the teacher in the teaching of such subjects as History, Geography, Nature Study, Civics, Hygiene, etc.

Can the Art and Archæological sections help in the teaching of History by making available for the use of teachers in the local schools an outline of the exhibits in their collections which would be directly helpful in the teaching of this subject and by supplying information in the shape of lectures and lantern slides relative to, let us say, places of historical interest in the city of Bombay, historical monuments in India, the Moghul period, the Peshwa dynasty, etc. ?

Can the Natural History Section help in the teaching of such a subject as Geography by supplying information through its exhibits and by lectures relative to the natural resources, and industries of the country ? i. e. Rice-growing, Wheat, Tea, Coffee,Forestry, Coal mining, Cotton and Cotton manufacture, Fisheries, Iron and Steel, etc. How far and by what methods can it co-operate in the teaching of Nature Study and High School Biology ? As regards Geography very little can be done at the present time as the space at our disposal in the museum is inadequate for the development of such sections as would particularly lend themselves to the task ; but as regards Nature Study and Biology much may be achieved.

Can the Museum help the schools by offering information on what the great Public Departments of Government and the Municipality are doing for the welfare of the country and the people in the city ?

Our programme of work, whatever it is, can only be effectively arranged by consultation with the educational authorities who should be in the best position to advise the museum as to the lines on which it should proceed. It is recommended therefore as a preliminary that this report should be circulated for opinion and advice among those who would best be able to offer it. A meeting could then be arranged at which the proposals put forward could be further discussed.

The next step would be to awaken the interest of the schools, by holding a special entertainment (I purposely call it entertainment because the gathering should be perfectly informal and conclude with refreshments) for the principals and teachers of the local schools where we could tell them briefly how we propose to help them. A lecture on the work of museums in America might serve as an introductory eye-opener.

The lines on which we could help are as follows :—

School Catalogue of Museum Exhibits

The preparation by each section of the museum an outline of the exhibits in its galleries which could be of direct assistance to the teacher in the teaching of various subjects prescribed in the curriculum for Secondary schools. From this outline the teachers would be able to know exactly what exhibits in the museum would be helpful in the teaching of a particular subject and could arrange with the museum for a class to see them under the guidance of the Curator or his assistants.

Lectures to Classes at the Museum

The preliminary lecture should always take the form of a conducted tour through all the galleries of the section, as, before interesting a child in a particular part of the museum, it would be necessary to satisfy his curiosity as to the contents of the museum as a whole. The ultimate aim of the guide lecturer should be to prepare a specific programme of lectures which should follow as far as possible the courses of study laid down in the school syllabus. This programme should be available for circulation among the schools at the commencement of each term. While this is in preparation classes might be held in the museum with the object of interesting the children in local forms of animal and plant life and other material the museum contains. These talks could be illustrated with museum material and should be given to the children in the lecture room. But in developing his programme of lectures the lecturer should remember that his objective is to establish a sympathetic relationship between the children and their environment viz. the city child's relationship with the world in which he lives. Subjects which concern the health, habits of life, the skill, intelligence, building, food getting, and other activities of man are as of vital interest to the child as the study of the lower forms of animal life. The schedule of lectures should be so arranged so as to give pupils from each school the opportunity of attending them at definite intervals during the school second term. During the present year while these classes are being held and the interest of the schools in the projects is being roused, work might continue on the preparation of a definite programme of lectures which should be ready for circulation among the schools at the commencement of the school term in 1928. In the preparation of this programme the lecture programmes of various American museums which are available might be studied with benefit. The guide lecturer will go through a list of the schools who are co-operating in the scheme, he will give each school certain hours and dates at which lectures can be arranged for. The principal of the school will receive this notice specifying the time and the dates at which his classes could be accommodated and will signify his approval or suggest a change. The lecturer will thus know what his programme of lectures is to be, the time and the dates and the number of pupils he can expect.

Museum Courses

When the system of lectures has been developed sufficiently a commencement might be made with museum examination courses, when sets of printed questions might be given to the pupils, the answers to which are to be arrived at by examination of museum material exhibited in a particular gallery. The examinations should be conducted as in a class room and attendance should be compulsory. A prize might be offered to the pupil obtaining the highest percentage of marks, or classes from various schools might compete.

Museum games, as described in the body of this report, might also be held at the close of the lectures as a valuable method of judging the efficiency of the teaching and giving good brain-stretching exercise to the child.

Museum entertainment

We should consider the possibility of holding at the museum during the year one or two entertainments to which as large a number of children from the local schools as possible should be invited. The programme should be made up of motion pictures of educational interest, i.e. travel films, nature and health films, etc. (I feel certain that the local firm of Pathe Freres would help if properly approached. The Haffkine Institute also has some suitable films and I believe the Railway companies also have suitable films of travel in India which they might possibly loan). Lantern lectures and nature talks could help to fill the programme.

EXTRA-MURAL SERVICE

As I have already stated, a very important phase of the museum's extra-mural service is the providing of lantern slides, and lectures for the use of teachers in the schools. We should endeavour therefore, while developing our lecture service in the museum galleries gradually to amass the material for this purpose.

The cheapest way would be for the museum to prepare its own slides by engaging a photographer and giving him the material and the facilities for carrying out this work. A large amount of material could probably be collected by appealing to various public departments, railway and transport companies, and commercial and industrial concerns. The American Museum built up a large proportion of its stock of slides in this manner. As the museum was offering publicity to these organizations in the work it proposed to do there was a natural desire to co-operate on the part of those to whom the museum appealed. Lastly a number of slides might be obtained through exchange. The American museums are anxious to obtain Indian material for their collections. Specimens illustrative of American animal life which they would normally give us in exchange would not be of much use to us as our sphere is limited at present to the Oriental Region but they could and are willing to help by supplying us with material from their Education Department. A glance through their catalogue of slides will show how many of the subjects covered would be directly applicable to our own use. After consultation with the Director, I am able to state that the

American Museum, New York, would be glad to enter into this system of exchange which would be mutually helpful.

In collecting the material a definite policy should be adopted, viz., that the subjects selected should have a direct bearing and relation to the teaching in the schools. In the appendix to this report which I am unable to publish here, I have endeavoured to indicate the lines on which we should collect our slide material, I have grouped them under subject headings, and have tried to show the possible sources of supply.

I have already indicated the various methods adopted for cataloguing and storing these slides but this is a matter which can be more fully considered when we have amassed a sufficiency of material.

Lectures delivered by the Museum Lecturer in the Schools

The advantages of this method, which enables the museum considerably to extend its sphere of utility and to reach a far larger number of pupils than it would by its normal lecture service in the galleries, need not be stressed. We could perhaps commence by setting aside one day in the week on which our lecturer could visit say three schools, the next week three others could be visited. We would by this means be able to take in a large percentage of the schools. The system would have the direct effect of increasing the interest of the schools in the museum and would also have a good effect on our lecture service in the galleries. I recommend a trial of the system and the formation of a programme of work suitable to conditions in the city.

Circulating Collections

The formation of suitable exhibits for circulation among the schools is purely a question of funds. I propose during the year to prepare one or two cases suitable for this purpose, as an experiment. At the Field Museum the whole cost of preparing these cases was covered by a single donation. At the Brooklyn Museum the circulating collections for the schools were established and financed by the Women's League, an organization similar to our Bombay Women's Council. Here is a field of activity which might be offered to the local Women's Council by which they could actively co-operate in the education of the children of the city. It is possibly a source from which we might obtain assistance and is worth trying.

The Museum and the Scout Organizations

The Boy Scout and Girl Guide organizations in Bombay present a very suitable field for our activities and it is recommended that the passages in this report which have reference to the work done by museums in America and thes organizations be forwarded to those who have control of the movement in Bombay. A meeting might then be arranged at which we might formulate plans by which we could co-operate with the scouts both in the museum and in the training camps. The holding of classes and demonstrations for Boy Scouts and Girl Guides at the museum and the methods by which we could help at the training camps are points which might be considered.

Work for the Blind

Finally we should consider the possibility of holding at least once or twice during the year a class for the children from the local blind school. Examples of corals, shells, mounted birds, mammals and reptiles might easily be arranged in trays so that the children could handle them. They would then be given a talk on these specimens and then be allowed to re-examine them. It would be a means of bringing pleasure into their otherwise colourless lives.

INDIAN DRAGONFLIES

BY

Lt.-Col. F. C. Fraser, I.M.S., F.E.S.

Part XXVII

(With one Text-figure and four plates)

(Continued from page 889 of Vol. XXXI)

Suborder—Zygoptera

Head transversely elongate; eyes more or less widely separated, usually more so than in genus *Gomphus*; vesicle usually absent, ocelli lying free in middle of vertex; labium with middle and lateral lobes approximately equal, the midlobe deeply fissured; wings usually identical in shape, the hind dilated occasionally at their middles, never at the base; trigones represented by a foursided, irregular structure (hereafter called the *discoidal cell*), which may be squared, or obtusely or acutely pointed outwardly; pterostigma usually present, occasionally absent in one or all wings, variably shaped; antenodal nervures numerous or reduced to the two primitive pairs; wings usually held closed together when at rest; a pair of superior anal appendages at end of 10th abdominal segment, and a pair of inferior anal appendages at sides of anal orifice; female with well-developed ovipositor somewhat similar to that of *Gynacantha*.

Larvæ variably shaped, possessing caudal gills, two to three in number which show a great variety in shape and size, spine-like, vesiculated or padddle-shaped; breeding in still or running water, more often in the latter.

[Since this series of papers was started in 1918, our ideas on the venation of a dragonfly's wing has undergone very radical changes, and this the result of the finding of several most important fossil dragonfly wings which throw a flood of light on the problem. We now find that instead of a many branched medius, we have a many branched radius, and that the vein we have known as *Cui* is really *Cuii*, the former being absent in living Odonates, and further that the vein we have been accustomed to regard as *Cuii* is in reality *IA*. We are indebted to Lameere and Dr. R. J. Tillyard for this interpretation, and as it now brings the dragonfly venation into line with other orders of insects, and is certain to be generally adopted in the future, I propose to take the opportunity offered by the introduction of a new suborder, to introduce the new nomenclature.

The following table and figure will assist the reader in rearranging his ideas on the venation and will be amplified from time to time.]

New Notation (Tillyard's)		Old Notation (Needham-Comstock)	
Costa	C.	Costa	C.
Subcosta	Sc.	Subcosta	Sc.
Radio-median	R + M.	Radio-median	R+M.
First Radius (main stem)	Ri.	Radius	Ri.
Arc.	Arc.	Arc	Arc.
Second Radius (first branch).	Rii.	First branch of median	Mi.
Intercalated branch of *Rii*	IRii.	First intercalated branch of median	Mia.
Third Radius (second branch)	Riii.	Second branch of median	Mii.
Intercalated branch of *Riii*	IRiii.	Subnodal sector	Rs.
Fourth and fifth Radius combined	Riv + v.	Third branch of median.	Miii.
Anterior median (medius ant.)	MA.	Fourth branch of median.	Miv.
Posterior median (medius post.)	MP.	Absent in all dragonflies.	

New Notation (Tillyard's)		Old Notation (Needham-Comstock).	
First cubital nervure	... Cui.	(Absent in all dragonflies)	
Second cubital nervure	.. Cuii.	First cubital nervure	... Cui.
First Anal nervure	... IA.	Second cubital nervure	... Cuii.
Cubito-anal nervure	... Cuii + IA.	Cubital nervure	... Cu.
Second Anal nervure	... A′.	Postcostal nervure	... A.

The *Zygoptera* are divided up into two large families distinguished by the number of antenodal nervures, as follows :—

1. Only two antenodal nervures : discoidal cell usually entire ; arc midway between base of wing and node, or nearer node than base ; usually small insects.

Cœnagrionidæ.

2. More than two antenodal nervures, never less than five ; discoidal cell usually traversed but sometimes entire ; arc nearer base of wing than node ; larger insects.

Agrionidæ.

The *Agrionidæ* are divided up into three large sub-families as follows :—

1. Sectors of arc arising from the lower third of arc ; discoidal cell convex coastalwards and as long as or nearly as long as the basal space ; pterostigma often absent in both sexes, or much reduced or false in character.

Agrionidæ.

2. Sectors of arising from the middle or above the middle of arc ; discoidal cell rarely convex costalwards and shorter than basal space ; pterostigma elongate and well developed in both sexes.

Epallaginæ.

3. Wing characters same as last, but male sometimes with the pterostigma occasionally absent in forewing ; abdomen much shorter than wings ; epistome (or nose) enormously developed so as to form a tumid nasal structure on the front of face.

Libellaginæ.

Subfamily—LIBELLAGINÆ, Laid.

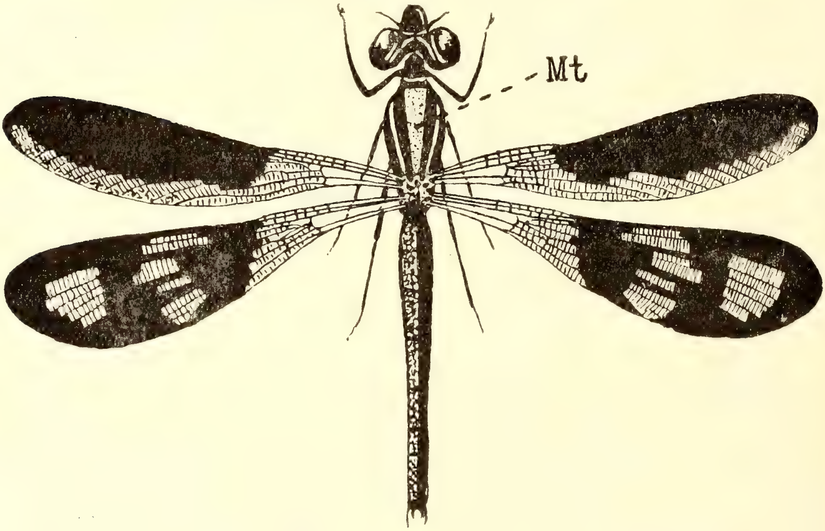


Fig. 1.—*Rhinocypha spuria*, Selys, male
Mt.=Mesothoracic triangle

Head robust, triangular ; eyes oval, large, projecting posteriorly, moderately separated from one another ; frons horizontal, rather longer than broad ; occiput linear, very narrow ; face projecting, as long as the head is broad, ante- and post-clypeus very tumid and projecting, rounded and vesiculated; labium slightly longer than broad, split nearly to its base into two narrow triangular parts; labrum oval; antennæ with rudimentary first segment, second segment cylindrical, the most robust of all, third segment slenderer and longer, with its apex slightly tumid, terminal or apical segment longer than the third.

Prothorax elongate, narrower in front than behind, the anterior border raised, the hind with a large lobe, tumid and oval in shape.

Thorax moderately robust, compressed, forming about one quarter the total length of body, elongate, the dorsum flattened, the midthoracic carina often bifid so as to enclose a triangular space variable, in length, extending from one-fourth to the whole length of carina (when present, known as the 'midthoracic triangle,' and important for differentiating species).

Legs long and slender, extending to the apical end of segment 4 in males, to the end of segment 7 in females. Femora and tibiæ with long hair-like spines; tibiæ sometimes dilated, often densely pulverulent on the flexor surface; tarsal claws with a small spine at end, barely visible in some (*Rhinocypha*).

Wings hyaline or opaque, metallic or iridescent in the males, usually uncoloured in the females, of the same shape and size, but in some genera, the hindwings distinctly broadened, always longer than the abdomen, especially in the female long and narrow, markedly petiolated; reticulation close, cells tetragonal in shape. *Rii* and *I Rii* not fused with *Riv + v*: node nearer base of wing than apex; basal space entire, slightly longer than half the cubital space; discoidal cell straight, very narrow, traversed by one or several nervures, about one-third shorter than the basal space, its ends squared or the outer oblique; arc nearly straight or markedly bent, its sectors arising from near the middle from a single point or moderately separated; *Cuii* nearly straight or making a costal-wards curve after leaving the discoidal cell; *IA* without an inferior branch, straight or curved posteriorwards or undulated; no intercalated sectors between *Cuii* and *IA*; most sectors running straight, with but a little curve towards the termen of wing; many intercalated sectors; 4 to 20 antenodal nervures, the first and second or third being the primaries, all others not coinciding in the costal and subcostal series; pterostigma present in all wings, except in the forewings of *Micromerus* males, long and narrow.

Abdomen broad, depressed, especially in the male, short, segments 1 and 2 very short, the remainder nearly equal in length, squared.

Anal appendages all very similar, the superiors twice as long as segment 10, cylindrical, slightly broader at base, curved pincer-like towards one another at apices; inferiors very short, more robust, cylindrical, blunt at apices.

Genitalia variable in the genera.

Distribution. Africa, S. Asia, the Philippines and Australia.

Four genera found within Indian limits:—

1	Sectors of arc separated at origin; a pterostigma present in all four wings of both sexes ...	2
	Sectors of arc arising from a common point; forewings of male without a pterostigma	*Micromerus*, Ramb.
2	Wings stalked (petiolated) to far distal of the nervure *ac* (cubital nervure)	*Calocypha*, gen. nov.
	Wings petiolated to slightly proximal of the cubital nervure	3
3	Wings (at least the hind, except in *immaculata*) coloured in the male; *IA* not undulated at its origin	*Rhinocypha*, Ramb.
	Wings uncoloured in both sexes; *IA* undulated from its origin	*Libellago*, Selys.

Genus—RHINOCYPHA, Ramb.

Rhinocypha, Ramb. Ins. Nevrop., p. 232 (1842); (*Libellago*, pars) Selys, Mon. Lib. Eur. p. 200 (1840); Id. Syn. Calop., p. 59 (1853); Id.

Mon. Calop., p. 198, (1854) ; Walk. List. Neur. Ins. B. M., iv, p. 645 (1853) ; Burm. (*Calopteryx*, pars) Handb. Ent. ii, p. 826 (1839) ; Percheron (*Agrion*, pars), Gen. Ins. Neur. t. 2 (1835) ; Guerin (*Agrion*, pars) Mag. Zool. i. Ins. t., 15 1831).

Characters as for the subfamily ; wings of male, less rarely of female also, coloured vividly with metallic blues, violet, green or fiery coppery, at least in the hindwings, often with clear vitreous spots and stripes on hindwings which glow with opalescent rainbow tints ; antenodal nervures numerous, always more than six in number ; *IA* not undulated at its origin ; petiolation always ending proximal to *ac ;* shape of wings very variable, either all four very long and narrow, or the hindwing considerably dilated. Mesothoracic triangle nearly always present and brightly coloured in most species, of variable length, sometimes extending up to the alar sinus, but often much shorter than this. Legs long and slim, the hind pairs of tibiæ nearly always pruinosed white or yellow. Anal appendages as for subfamily.

Larva Body short and robust, head squarish, the eyes representing the outer angles, antennæ seven jointed, the segments becoming progressively smaller from base to apex ; prothorax small, furnished with four small protuberances on the dorsum ; wing-cases lying parallel along the dorsum ; abdomen short and cylindrical ; legs of great length in the earlier instars, of moderate length in the adult, hind tibiæ extending to a short distance beyond anal end of abdomen, minutely spined, striped with pigment ; mask deeply bifid in the final instars, the edges of the fissure usually overlapping to enclose a small foramen, very long and flattened, extending as far as base of middle pair of legs in the adult, furnished with two lateral setæ and three hooks which may be bifid at the apex, moveable hook of great length ; caudal gills two in number, triquetral in shape, heavily spined, the 11th abdominal tergite present as an appendix dorsalis unmodified as a gill. Gizzard with sixteen folds each bearing four to five teeth. Found in running water, usually montane or submontane streams, clinging to weed or submerged twigs, etc.

The *Rhinocypha* as a whole, form a large genus of medium sized dragonflies, which possesses some of the most beautiful insects of the world. Not only do their wings display an inimitable play of scintillating colours, ranging through blues, greens, violet, pink to gorgeous fiery coppery red, but the bodies in most cases are also gaily decorated with red and blue or yellow of many shades. The picture afforded by a couple of males, circling round one another, their wings glittering with multitudinous rainbow hues, as they compete for the affections of an admiring female, is not readily forgotten. They are the living gems of tropic streams and delight the eye of even a casual observer.

When mating, the males perform a kind of nuptial dance before the female, during which they make a great display of the white pulverulent flexor surface of the hinder pairs of tibiæ. The legs are trailed and show up dazzlingly white in the strong sunshine.

Meanwhile the forewings flutter rapidly to support the insect, whilst that the hinder pair are held flat to display their wealth of colour. The female, perched on a prominent twig beside the stream, appears to be totally unconcerned by its mate's efforts to attract her. One very rarely sees a pair in cop, although vast numbers of both sexes may be present on the banks of the stream.

Less rarely a female may be seen ovipositing on a floating twig or broken reed.

In spite of the large number of species, it is extremely difficult to establish relationships, and their distribution presents many apparently insoluble problems. Roughly the whole genus may be split up into two large divisions.

Those with narrow wings, the hind scarcely broader than the fore, and in which *Riii* is widely separated and distad from the subnode.

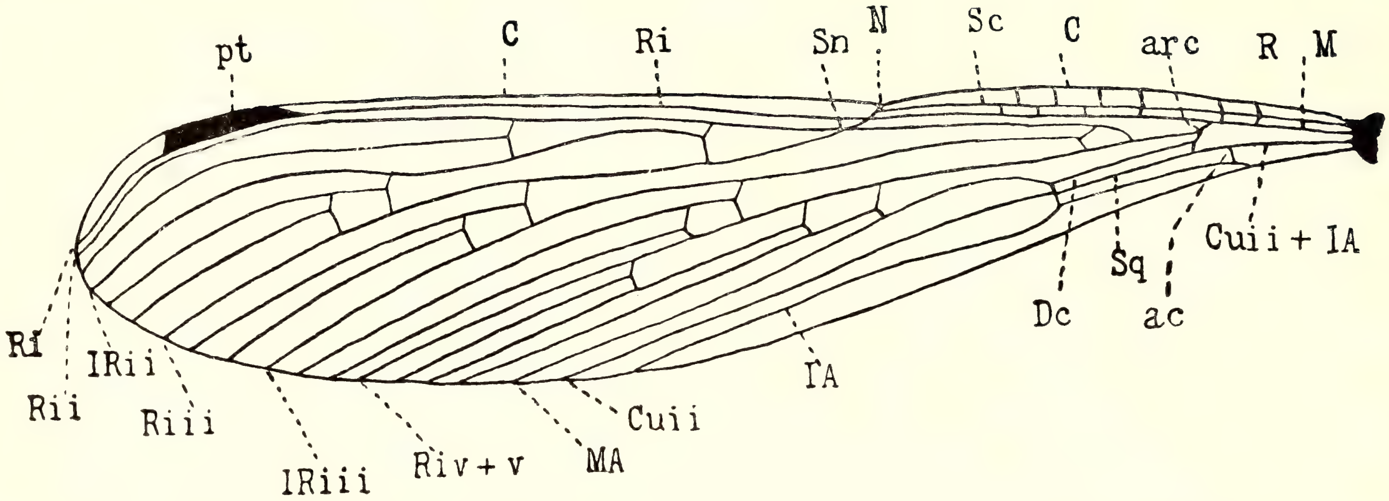
(E.g.,—*biforata*, *perforata*, *bisignata*, etc.).

Those with broader wings, the hind usually being much broader than the fore, and in which *Riii* comes off from the subnode.

(E.g.,—*cuneata*, *spuria*, *quadrimaculata*, *ignipennis*, etc.).

Ignipennis, *trimaculata* and *unimaculata* are clearly fairly closely related, not only from the colour of the wings, coppery in all, but also from the fact that all have an aborted mesothoracic triangle.

Iridea which shares this latter character, I am inclined to view also as closely related as the forewings are often coppery.


pt
C
Ri
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Cuii + IA
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Riv + v
IRiii
Riii
IRii
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HINDWING OF *Rhinocypha immaculata*, SELYS, SHOWING THE MAIN AND INTERPOSED NERVURES ONLY
(For interpretation, see the Table of Notation given in the text.)

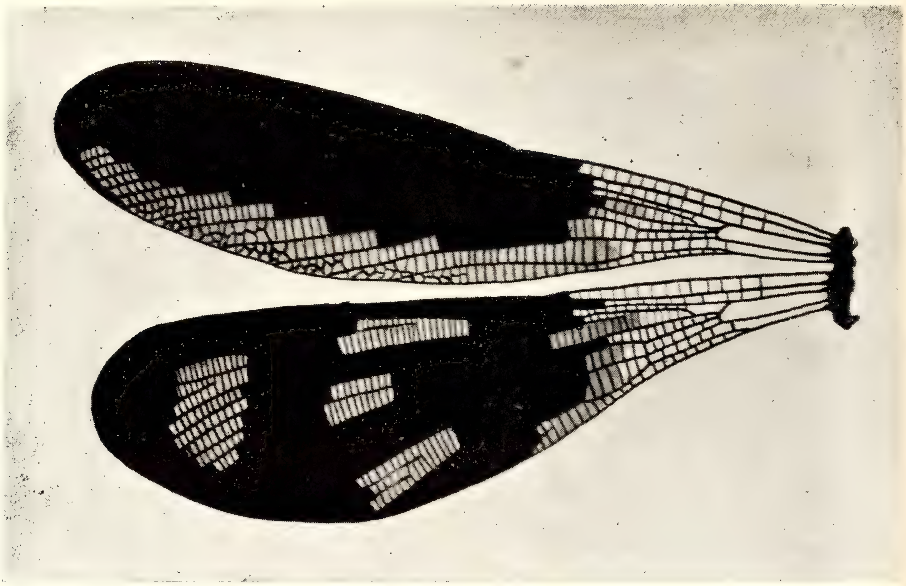


Fig. 1

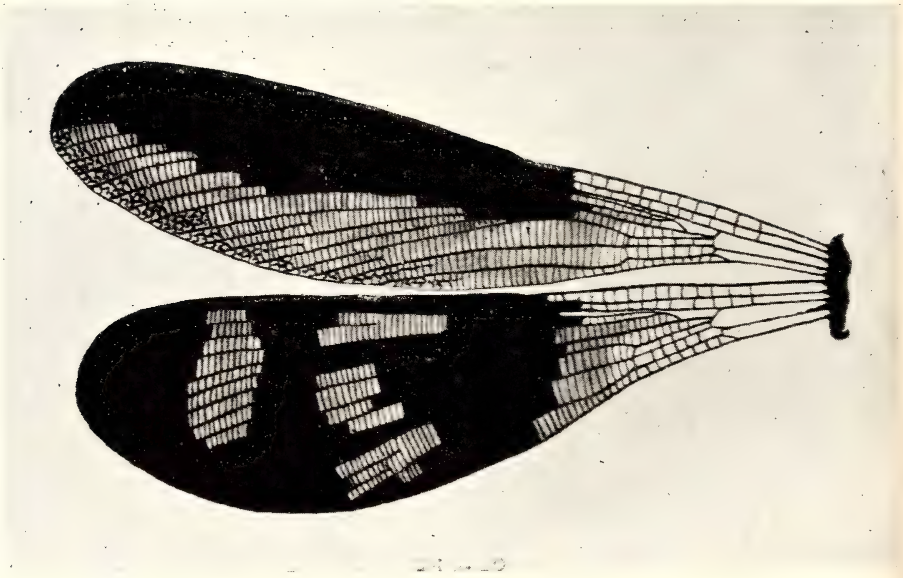


Fig. 2

Fig. 1. Wings of *Rhinocypha cuneata*, Selys, Male.

Fig. 2. Wings of *Rhinocypha quadrimaculata*, Selys, Male.

The black areas are steely blue or green, the shaded areas are vitrified and glow with blue, green, violet reflex according to the angle from which viewed.

A quite natural series, which may indicate a possible line of evolution is as follows :—

R. immaculata—hilaryæ—bifasciata—trifasciata—bifenestrata—spuria—and so on to the *fenestrella* group.

So far as the seventeen Indian species are concerned, it is possible to place them in four more or less natural groups, of which group *perforata* appears to be the most primitive.

Group I. *Fenestrella*

The third branch of radius (*Riii*) arising at the subnode ; wings opaque black with iridescent vitreous spots of blue, violet, or emerald green ; hindwings considerably broader than the fore ; mesothoracic triangle very large, extending to antealar sinus, coloured .—*cuneata—spuria—fenestrella—quadrimaculata*.

Group II. *Fasciata*

The third branch of radius arising at the subnode or very slightly distad to it ; wings hyaline or the hind marked with one or more opaque black bands running from costa to posterior border ; hindwings only slightly broader than fore ; mesothoracic triangle very large, extending to antealar sinus, coloured.—*immaculata—hilaryæ—bifasciata—trifasciata—bifenestrata*.

Group III. *Unimaculata*

The third branch of radius arising from the subnode or slightly distad of it ; wings fiery coppery metallic with iridescent vitreous spots of pink, violet or green (*iridea* has the hind wing and costal border of forewing opaque black with golden, or violaceous vitreous spots and stripe) ; hindwings usually broader than the fore ; *mesothoracic triangle obsolete.—unimaculata—ignipennis—trimaculata* and *iridea*.

Group IV. *Perforata*

Third branch of radius arising well distad of the subnode ; hindwings not broader than the fore, both pairs very narrow ; hindwings opaque only in the outer third or half, this area marked with one or two rows of iridescent vitreous spots ; mesothoracic triangle short, not extending more than half-way towards the antealar sinus.—*perforata—biforata—bisignata—whiteheadi*. (To this group also belongs *beatifica*, Fras., a race of *perforata*, and *beesoni*, Fras., a race of *biforata*.)

For the rest *adamantina*, Forst., is synonymous with *cuneata*, or at the most, merely a race of that species, whilst *hemihyalina*, Fras., is a race of *quadrimaculata*. Lastly *laidlawi* is transferred to a new genus.

Key to Indian species of *Rhinocypha*.

1.	Wings uncoloured in both sexes	*immaculata*, Selys. (Assam.)
	Wings coloured, at least partly, in the male. ...	2
2.	Dorsal mesothoracic triangle extending as far as root of wings	3
	Dorsal mesothoracic triangle either absent, uncoloured or extending not more than half-way up to root of wings	8
3.	Hindwings of male with opaque bands	4
	Hindwings of male opaque with vitreous spots ...	6
4.	Hindwings of male with the apex narrowly black and an incomplete (more rarely complete) black band just proximal to pterostigma	*hilaryæ*, Fras. (Upper Burma.)
	Hindwing with the apex narrowly black and a black band lying about midway between pterostigma and node	*bifasciata*, Selys (Assam.)
	Similar to last but with a third, incomplete black band at the level of node	5

5. Apical, medial and nodal bands separated ... *trifasciata*, Selys. (N. W. Provinces.)

All three bands connected narrowly along costal and hinder borders of wing, thus enclosing two large spaces .. .. *bifenestrata*, Fras. (Assam.)

6. The large apical vitreous spot separated from the costal border by not more than one or two rows of cells ... ... *cuneata*, Selys. (Assam and Bengal.)

Apical vitreous spot separated from costal border by at least three or four rows of cells 7

7. Apical vitreous spot moderately small, lying exactly under pterostigma, medium-sized species ... *fenestrella*, Ramb. (Burma, Indo-China, Borneo.)

Apical vitreous spot large, lying almost entirely proximal to line of pterostigma, large species, hindwing 27–28 mm., mid row of vitreous spots more or less confluent ... ... *spuria*, Selys. (Bengal, Assam and Sikhim.)

Apical vitreous spot moderately large, lying partly proximal to line of pterostigma, small species, hindwing 20–24 mm., mid row of vitreous spots always well separated, the costal one extending much nearer to node than the middle spot ... *quadrimaculata*, Selys. (N. India.)

8. Mesothoracic triangle uncoloured, or entirely obsolete ; hindwing distinctly broader than forewing... 9

Mesothoracic triangle coloured, extending from one-third to half-way up dorsum ; hindwing nearly the same breadth as fore 12

9. Wings fiery burnished coppery metallic ; no opaque ares in forewings... 10

Wings opaque black, the hind with a sickle-shaped vitreous spot at distal end, which partially encircles the outer row of vitreous spots ; costal border of forewing narrowly black nearly as far as node ... *iridea*, Selys. (Upper Burma.)

10. Hindwing with a large subquadrate violety green vitreous spot at its centre ; very large species ...*unimaculata*, Selys. (Bengal and Assam.)

Hindwing with a medial row of vitreous spots and an inner linear spot 11

11. Small species, hindwing 23 mm. or less ; inner vitreous spot very elongate .. .. *trimaculata*, Selys.

Larger species, hindwing 26 mm. or more ; inner vitreous spot much shorter ... ... *ignipennis*, Selys. (Both from Assam.)

12. Only the apical third of hindwing opaque; a single row of vitreous spots 13

The apical half of hindwing opaque , two rows of vitreous spots ... ... *perforata*, Perch., and race *beatifica*. (Assam, Burma, S. Asia.)

13. Mesothoracic triangle very small, pink ; vitreous spots elongate ; only extreme apex of forewing tipped with black ... ... *biforata*, Selys. (Burma.)

Mesothoracic triangle larger, extending half-way along dorsum, pink ; vitreous spots shorter ; apex of forewing tipped with black as far as inner end of pterostigma ... ... *biforata*, race, *beesoni* Fras. (Burma, Assam.)

Similar to the last, but nearly the apical third of forewing black ... ... *bisignata*, Selys. (Peninsular India, south of the Himalayas.)

Mesothoracic triangle small, blue ; an isolated vitreous spot distal to the row of vitreous spots ; opaque area of forewing equal to that of hind, intensely black, the vitreous spots peacock blue ; wings markedly rounded at apices ... ... *whiteheadi*, Kirby. (Assam.)

1. **Rhinocypha cuneata,** Selys. Syn. Calop. p. 60 (1853) ; Id. Mon. Calop. p. 206 (1854) ; Walk. (*Libellago cuneata*), List. Neur. Ins. B.M., iv, p. 650, n. 14 (1853) ; Kirby, Cat. Odon., p. 113 (1890) ; Will. Proc. U.S. Nat. Mus., vol. xxviii, pp. 173, 174 (1904) ; Laid., Rec. Ind. Mus., vol. xiii, p. 36 and Pl. 11 (1917). Forst. (*adamantina*), Ann. Mus. Nat. Hung., p. 547 (1903).

Male. Abdomen 24 mm. Hindwing 27-28 mm.

Head. Ground colour velvety black, labium black, labrum black with a pale blue spot on either side, rest of head unmarked save for a tiny spot of rust red on the outer side of the ocelli, and another smaller, bluish, on each side of occiput. Eyes brown.

Prothorax black with a pale blue longitudinal streak on the middorsum of posterior lobe.

Thorax black, the mesothoracic triangle very large, extending as far as the antealar sinus, pointed at apex, palest blue in colour, a tiny humeral point just behind the upper end of the humeral suture, a linear streak along the anterior border of the second lateral suture, not extending up as far as wing roots, and dividing into two small spots below ; lastly an upper short streak on the metepimeron, all reddish yellow.

Legs black, the two hinder pair of tibiæ pure white on flexor surfaces from dense pruinescence, the distal portion of the hind femora less so.

Wings opaque from apices to about 5-7 cells proximad of node, the bases hyaline, palely saffronated. The opaque area in forewings occupying roughly about the costal half of the wing, the hinder border of this area serrate. In the hindwings this area begins 4-5 cells proximad of node and runs obliquely back and out from this point in a very irregular and serrate manner, leaving a vitreous streak of pale violaceous anterior to the discoidal cell, which deeply indents the opaque area and runs inward to a little beyond the inner end of discoidal cell. The inner border of the opaque area, posterior to the discoidal cell is also violaceous vitreous. The opaque area presents a medial row of spots, all more or less confluent and presenting an infinite variety of patterns. The anterior or costal spot lies between *Ri* and *Riii* (first and second branches of radius) and is usually separated from the hinder two, it extends inward well beyond the others. The hinder spots usually confluent, extending to within one cell row of hinder border of wing. In addition to this medial row, a very large preapical spot extending from *Ri* nearly to hinder border of wing, oval in outline, its inner and outer borders serrate, its outer border in line with the inner end of pterostigma. The latter black with an elongate spot of pale blue at its centre. The iridescent spots and vitreous hinder area of forewings peacock blue or pale violaceous according to which angle viewed from. Abdomen black, unmarked. Superior anal appendages slender, sub-cylindrical, simple, curved in at apices ; inferior half the length, moderately separated, slightly curved in at apices.

Female. Hindwing 28-30 mm. Abdomen 21 mm.

The female has hitherto been undescribed. The following description is made from specimens from Turzum, near Darjeeling :—

Head marked as for male but with the following additional spots, all bright gamboge :—a small pot on each side of the anterior ocellus and just anterior to its level ; a large spot at the base of antennæ, a pyriform spot on each side of the frons, the cheeks narrowly, the bases of mandibles, and finally a small spot or stripe on each side of rhinarium.

Prothorax black marked with bright gamboge as follows:—a median streak on dorsum of posterior lobe as in male, a short streak on sides and a large oval spot laterally, just below posterior lobe.

Thorax black marked with bright gamboge as follows:—fine lines on the humeral and median lateral sutures, incomplete below, the same markings as seen in the male but considerably broader, especially the metepimeral marking which is broad and roughly triangular, finally a minute antehumeral streak on the lower part of thorax. The mesothoracic triangle mapped out in lines of yellow.

Legs black, not pruinosed. Wings hyaline, evenly enfumed throughout, so that they appear brown when overlapping and folded over dorsum.

Abdomen black marked with gamboge as follows:—the dorsal carina finely as far as segment 7, a zigzag lateral stripe on segment 1, a lateral basal longitudinal stripe and an apical spot on segments 2 to 4, and the spot only on segments 5 to 7. A ventro-lateral stripe on segments 2 to 6. In some specimens many of these markings are more or less obsolete, the younger specimens being as a rule the better marked.

Anal appendages black, pointed, cylindrical as long as twice the length of segment 10. Vulvar scale very robust, extending to end of abdomen. Pterostigma brownish black clouded with enfumed white, oblique and rather squared distad, pointed within.

Distribution. Northern Bengal and Assam. I possess specimens from Gopaldhara, Assam and Turzum, Darjeeling District, also from Mangpu, in the latter district, collected by Messrs. H. Stevens, Oscar Lindgren, and Chas. M. Inglis. The type is said to have come from Thibet and may well have done so, it is a male in the Selysian collection.

R. adamantina Forst. (Ann. Mus. Nat. Hungarici, p. 547 (1903), is obviously merely a variety of this species.

The species is easily distinguished by the apical vitreous spot encroaching to within one or two cells of the costal margin of the wing.

2. **Rhinocypha spuria,** Selys., Bull. Acad. Belg. (2), xlvii, p. 388 (1879), Kirby, Cat. Odon., p. 113 (1890); Selys, Ann. Mus. civ. Genov. (2) x (xxx), p. 59 (1891); Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 173, 174 and 177 (1904); Laid. Rec. Ind. Mus., vol. xiii, pp. 36 and 37 (1917).

Male. Hindwing 27–28 mm. Abdomen 24 mm.

Head black marked with citron yellow as follows:—a small oval spot on the outer side of each posterior ocellus and a tiny occipital spot on each side, these markings being similar to those of *cuneata*. Labium black, labrum unmarked.

Prothorax black marked with citron yellow as follows:—a linear streak on the middorsum of posterior lobe and a small spot at each of its outer angles, another larger spot below this and a large triangular spot on each side of middle lobe.

Thorax black marked with yellow:—an upper linear antehumeral spot, an upper humeral stripe broken above, hugging the hinder border of humeral suture, a broad irregular stripe on the sides on the hinder part of the mesepimeron and an elongate triangular streak on the hinder part of metepimeron, which is often broken in two; lastly and occasionally a small spot on the upper part of mesepimeron and a tiny streak along the upper part of first lateral suture. All these markings, both prothoracic and thoracic subject to variability, the prothoracic and the smaller markings on the thorax often obsolete. Mesothoracic triangle very long and broad, lilaceous.

Legs black, the two hinder pairs of tibiæ snowy white from pruinescence on the flexor surface.

Wings opaque black with a steely blue or green reflex in the outer three-fourths, marked with vitreous spots and areas of lilaceous or purple. In some lights these spots have a mother-of-pearl reflex.

In the forewing, the opaque area covers the costal three-fourths of the wing, the vitreous area posterior to it having a beautiful violaceous reflex, the border of the opaque area markedly serrate. Inwardly it begins four cells proximad of node and has a markedly jagged border. In the hindwings the same area begins about 2–3 cells proximad of the node and is indented by two vitreous areas, the anterior of which extends in for a distance of 4–5 cells, the hinder, which is on the wing border, for a distance of 3–4 cells. The vitreous areas in this wing consist of a middle row of spots and an apical, the latter lying with its outer two-thirds under the pterostigma, and nearly quadrate in shape, being bounded by *IRii* and *IRiii.*

The middle row of spots are rather variable, consisting of four linear spots, the anterior or costal one made up of 2 rows of cells, the next of 2 or 3 at its outer end, the third of some isolated cells and the hinder of 2 or 3 rows at its outer end. The inner border of these four rows form a slightly convex outline, the second being a little more distad than the others. About 20 antenodal nervures in both wings ; four to five traversing nervures to the discoidal cell.

Pterostigma blackish brown, marked with a very large elongate lilaceous spot in the hindwings.

Abdomen black with dark metallic reflex, segment 1 with a small lateral yellow spot, 2 and 3 with a linear streak along the ventral border. Anal appendages similar to those of *cuneata.*

Female. Abdomen 22 mm. Hindwing 30 mm.

Head velvety black marked with bright ochreous spots, labium black, the lateral lobes white, labrum black, the whole of the central area yellow, deeply notched by a tongue-like prolongation of the black at base of labrum. In addition to the spots found in the male, the basses of mandibles broadly, the cheeks and basal segment of the antennæ, a small triangular spot on each side of rhinarium. a large triangular spot on each side of upper surface of frons, a small spot on each side of the anterior ocellus and lastly a small medial oval spot on occiput yellow.

Prothorax marked as for the male but rather more extensively.

Thorax with similar yellowish markings as in the male but these greenish yellow in hue and much more extensive. The upper and anterior lines bordering the humeral and first lateral sutures are generally complete and the antehumeral marking becomes a well-marked stripe extending in a curved manner inwards from the upper end of the humeral suture towards the antealar sinus and then straight down the whole length of the dorsum parallel to the mesothoracic triangle which is finely outlined in yellow.

Wings evenly enfumed and palely saffronated throughout, hyaline, unmarked. Pterostigma black, its central area ochreous. Fourteen to sixteen antenodal nervures in hind and forewings. Legs black, the two hind pairs of tibiæ pruinosed.

Abdomen black metallic with the following yellow markings : –segments 2 to 7 with the middorsal carina narrowly yellow, segment 1 with its apical border and a large curved or angulated lateral spot, segments 2 to 5 with a longitudiual basal stripe and an apical spot, as well as a ventro-lateral stripe. On segment 6, and sometimes 7, the apical spot only. Segments 2 to 6 with the apical border laterally yellowish.

Anal appendages and vulvar scale as in *cuneata.*

Distribution. Shillong, Assam, Kalaw, S. Shan States, Upper Burma, and Chin Hills. This species is one of the largest and most beautiful of the genus. It is specifically distinct from *quadrimaculata*, which is one of the smallest species of the genus. The difference in size is so striking, that when placed side by side, there is never any doubt as to which is which. Both Williamson and Laidlaw however express the opinion that, so far as descriptions go, the two are conspecific, so that it seems advisable to settle this point once and for all by pointing out the differences. In a large number of species I find :—

R. spuria	*R. quadrimaculata*
Distribution. Assam and Burma.	Distribution. Kashmir to Burma.
Reticulation of wings rather open.	Reticulation very close.
Vitreous stripes in hindwing invading the opaque black area for a distance of 3–5 cells.	Vitreous stripes extending distalwards into opaque area for a distance of 7–8 cells.
Apical vitreous spot nearly square, limited posteriorly by the nervure *IRiii.*	Apical vitreous spot transversely elongate, much narrower than long, extending one cell row posterior to *IRiii.*
Middle row of spots always 4 in number, the second spot from costal border equal in length to the hinder, inset but slightly, the inner border of pots shallowly concave.	Middle row of spots almost always 3 in number, the middlespot much shorter than the hinder and inset markedly to the others so that the inner border of spots is deeply concave.

Abdomen 24 mm. Hindwing 28 mm. Abdomen 19 mm. Hindwing 21 mm. The extent and shape of the apical spot is the best guide.

3. **Rhinocypha quadrimaculata,** Selys. Syn. Calop., p. 60 (1853) ; Id. Mon. Calop. p. 202 (1854) ; Walk. (*Libellago quadrimaculata*), List. Neur. Ins. B. M., iv, p. 651, n. 15 (1853) ; Kirby, Cat. Odon, pp. 112, 113 (1890) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 153, 174, 175 and 177 (1904) ; Laid., Rec. Ind. Mus., vol. xiii, pp. 36, 37 (1917) ; Fras. Mem. Pusa, Ent. Series, vol. vi, p. 54 (1921).

Male. Abdomen 19 mm. Hindwing 21 mm.

Head black with a small spot on the outerside of each posterior ocellus and a smaller spot on each side of the occiput. Labium and labrum black, unmarked.

Prothorax black unmarked. Thorax black marked with yellow as follows :—a fine humeral line interrupted below, and a moderately broad lateral stripe on the anterior border of the hinder lateral suture.

Occasionally a small elongate spot on the metepimeron, but this, as well as the humeral marking, usually absent (Teneral specimens have markings very similar to those of *spuria*, both on the prothorax and thorax, but although retained in adults of this species, they are invariably lost in adults of *quadrimaculata*, excepting the broader lateral stripe.) Mesothoracic triangle narrow, long, pink in colour.

Legs black, the distal halves of the two hind pair of femora and the tibiæ snowy white on the flexor surfaces from pruinescence.

Wings shaped as for *cuneata* and *spuria*, the hind considerably more broad than the fore, and dilated at the middle, opaque black with dark plum coloured steely reflex, and marked with vitreous areas and spots as follows :—an apical spot much broader than long, bounded by *Rii* costalwards, overlapping by one row of cells *IRiii* posteriorly, its inner and outer borders serrate. A medial row of spots usually 3 in number but occasionally 4, the anterior or costal spot made up of 2 rows of cells, and extending in towards the node much nearer than the other two spots of the series, the second or middle spot much shorter than the other two, and situated more distal than either. The third spot, when it exists, made up of 2 or 3 cells only. Lastly the posterior spot situated obliquely, so that its outer posterior corner may be in apposition with the hind border of wing, made up of 3 rows of cells. At the inner border of the opaque area, which is very irregular, are seen two deep indentations due to invasion of hyaline vitreous areas. These vary in extent but usually invade the opaque area for a distance of 6 to 8 cells. In the forewing, the opaque area covers the costal three-fourths of the wing, its hinder border being markedly serrate, and its inner border, which extends 4–5 cells proximad of the node, markedly dentate. The area posterior to the black area, vitreous and peacock blue or purple in colour according to the angle of view. The vitreous spots and areas in the hindwing purple or emerald green according to the angle from which viewed.

Antenodal nervures 16–18 in number : discoidal cell traversed 4–5 times.

Abdomen black with a vestigial lateral spot on the sides of the first segment and ventro-lateral stripes on third and fourth. Anal appendages as for *spuria*.

Female. Abdomen 20 mm. Hindwing 25 mm.

Head velvety black marked with ochreous spots as follows :—a reniform spot on the outer side of each posterior ocellus, a largish rounded spot on each side of the occiput and a medial oval or linear spot between and behind them on the hinder border of occiput. An oval spot in front of and on each side of the anterior ocellus, a large triangular spot on each side of the frons, a large spot on each side the rhinarium and a larger on the summit of that structure. The cheeks, bases of mandibles broadly, the second joint of the antennæ, and lastly two larger triangular spots on the labrum. Labium black, inner borders of lateral lobes yellowish white.

Prothorax black with a longitudinal medial stripe on the posterior lobe, and another rounded or triangular at each of its outer corners. A large oval mediolateral spot.

Thorax black marked with ochreous as follows :—the mesothoracic triangle finely mapped out in yellow, an antehumeral fine stripe, which begins at the upper end of the humeral suture, curves rapidly in and then down to anterior border of thorax, running parallel to the mesothoracic triangle. A fine posthumeral line, complete, running close to and behind the humeral suture, another finer line running close to the first lateral suture and separated narrowly from an upper spot on the mesepimeron. A broad irregular stripe bordering the anterior aspect of the second lateral suture and finally an elongate spot on the metepimeron.

Legs black, hind two pairs of tibiæ and femora sparsely pruinosed.

Wings moderately, deeply and evenly enfumed with brown ; pterostigma blackish with a diffuse yellowish centre more conspicuous distad.

Antenodal nervures 14 to 15 in number.

Abdomen black marked with yellow as follows :—a very large spot on each side of segment 1, a broad elongate spot at the base and an apical spot on the sides of 2, which are repeated on the sides of 3 to 7, but the elongate longitudinal basal spot linear and gradually shortening from segment to segment, segments 8 and 9 with only a lateral spot, largest on the latter segment. The dorsal carina narrowly yellow from segment 2 to 7.

Segment 10 unmarked, anal appendages and vulvar scale similar to *cuneata*.

Distribution. Rare in Burma, its zoo-centre seems to be about Nepal. I have seen specimens from Almorah in Kumaon, Falodhi, and there is a specimen in the Vienna Museum from Kashmir. Mr Chas. Inglis has taken it in Sikhim and around Darjeeling, but sparingly, whilst Col. F. Wall, has sent me specimens from Maymyo, Upper Burma. It has also been collected around Dehra Dun.

It would appear therefore that *quadrimaculata* is gradually replaced eastwards by *spuria* and *fenestrella*, but that it is specifically distinct from both. The differences between the former are set forth above under the description of *spuria*.

Race *hemihyalina*. Fras. Pusa Mem., l. c., p 64 (1921).

Male. Abdomen 23 mm. Hindwing 23 mm.

Differs from typical *quadrimculata* by the opaque area of the forewing covering only the costal half and by the apical vitreous spot in hindwing extending back to 3 rows of cells posterior of *lRiii*, instead of only one. The mesothoracic triangle is lilaceous as in *spuria*. The opaque area of the hindwing is sharply bevelled off proximad so that the vitreous spots indenting it are merged in the adjacent vitreous area, and the border appears regularly indented or serrate. There is a fourth row of cells vestigial in nature in the medial row of spots.

Female. Abdomen 21 mm. Hindwing 28 mm. Not differing from the type.

A pair from Shillong, Assam collected by Mr. T. Bainbrigge Fletcher, now deposited in the B.M.

It is uncertain where the type of *quadrimaculata* is, but it is probably in the Brussels Museum, in the Selysian collection.

In a male from the Naga Hills, in my own collection, the apical spot is similar to that of *hemihyalina*, but the forewing is as broadly opaque as in typical *quadrimaculata*.

4. **Rhinocypha fenestrella,** Ramb, Ins. Nevrop., p. 236 (1842) ; Selys. Syn. Calop., p. 60 (1853) ; Id. Mon. Calop., p. 204 (1854) ; Bull. Acad. Belg. (2) xlvii, p. 387, (1879) ; Walk. (*Libellago fenestrella*), List. Neur. Ins. B.M., iv, p. 650, n. 15 (1853) ; Kirby, Cat. Odon., p. 113 (1890) ; Will. Proc. U S. Nat. Hist. Mus., vol. xxviii, pp. 173–179 (1904) ; Laid. Rec. Ind. Mus., vol. xiii, p. 35–37 (1917).

Male. Abdomen 19 mm. Hindwing 21 mm

Head velvety black with an oval ochreous spot on the outer side of each posterior ocellus and another rounded spot on each side of the occiput. In the type, the former of these spots is vestigial and the latter obsolete, but in specimens from Borneo and Burma which I have examined, they are clearly visible.

Prothorax black with a longitudinal middorsal stripe on the posterior lobe, white. (Absent in the type.)

Thorax black with a bright citron yellow irregular stripe bordering the second lateral suture anteriorly, and an elongate spot on the metepimeron. The type has also a fine incomplete line on the humeral suture and another on the upper part of the first lateral suture. The mesothoracic triangle extending to the antealar sinus, palest pink or lilaceous. Four yellow spots beneath thorax.

Legs black, the two hinder pairs of tibiæ pulverulent white on the flexor surface.

Abdomen glossy black with steely reflex, the first segment with a small bright citron yellow spot on each side.

Wings hyaline at base, opaque black for the distal, three-fourths, the hyaline area tinted yellow, the opaque area steely green or blue, marked with vitreous spots which glow emerald green, lilaceous, mother-of-pearl or a beautiful rose pink according to the angle from which viewed. The opaque area in the forewing occupies variably the anterior three-fourths or half of wing, and in specimens from Sintang, Borneo, the vitreous area extends up at the apex as far as the pterostigma.

The hyaline area posterior to it in this wing and for some distance proximad at the base, is a beautiful vitreous peacock blue. The dark area has a very irregular border basad, and is markedly serrate behind.

In the hindwing, the opaque area begins about 5 cells proximad to the node and extends back in a very ragged manner as in *quadrimaculata*, leaving two deep indentations made by the bordering vitreous area exactly similar to *quadrimaculata*. In the Bornean examples the opaque area has a very oblique border, as seen in *hemihyalina*, so that these two indentations are barely visible from the other irregular serrations, and the bordering vitreous area is correspondingly broadened. At the apex of wing, *and situated exactly beneath the pterostigma* is a variably sized spot, but usually much smaller than the corresponding apical spot found in *cuneata*, *spuria* and *quadrimaculata*, being rarely more than 4 rows of cells in depth. Costalwards it is bounded by *IRii*, and posteriorly it extends about one row of cells beyond *Riii*, but is subject to slight variation from this.

The middle row of spots shows even greater variability, consisting of 3 or 4 spots, the two middle of which are often confluent. The spots do not vary markedly in length as a rule, as in *quadrimaculata*, and their inner and outer borders form a regular curve.

Pterostigma black, broadly lilaceous beneath, in the hindwing. Antenodal nervures 13 to 16 in number ; discoidal cell traversed 3 to 4 times.

Anal apendages similar to those of *quadrimaculata*.

Female. Abdomen 17 mm. Hindwing 24 mm. (Rambur type).
,, 19 mm. ,, 28 mm. (From Upper Burma).

Head black, marked exactly the same as in *quadrimaculata*, Prothorax similarly marked to *quadrimaculata*, but the two lateral spots much larger. Thorax with an antehumeral fine line broadening below, and curved out above along the border of the antealar sinus as far as the upper end of the humeral suture ; a fine line which starts above and behind the humeral suture, crosses its middle and ends shortly before the anterior border of thorax. Laterally the markings are similar to those of *quadrimaculata*. Below are found two long yellow spots shaped like the broad head of a stabbing spear. (These two spots serve to separate this species from the female of *quadrimaculata*.)

Legs black, the two hind femora distinctly pruinosed white.

Wings faintly and evenly enfumed tinted with yellow at the bases. Antenodal nervures 16–17 in number ; discoidal spaces traversed four times ; pterostigma black, dark yellow for the greater part of its centre.

Abdomen black marked with ochreous spots as follows :—a largish lateral spot on segment 1, a smaller apical spot on segments 2 to 7, and a ventrolateral stripe on segments 2 to 4. The middorsal carina very finely from segments 2 to 7.

Anal appendages and vulvar scale similar to *cuneata*.

Distribution. The type, a male taken in 1825 is supposed to have come from Malacca, and is in the Paris Museum. A second male was taken at Pulo-Penang Isle—Prince de Galles. A third male, which was in the Dale collection, now in the B.M., is labelled 'India.' The co-type female described by Rambur, is in the Paris Museum and is labelled as coming from China. I have males from Sitang, Borneo and a pair from Gokteik, just above Maymyo, Upper Burma, collected by Col. Wall. It is apparently found scattered throughout Southern Asia in submontane areas. The Rambur female is teneral and incomplete, the description given above is the first complete one and was made from Col. Wall's specimen.

Fenestrella is easily determined by the position of the apical spot on the hindwing, situated exactly under the pterostigma, whilst the female may be recognized by the markings on the underside of the thorax.

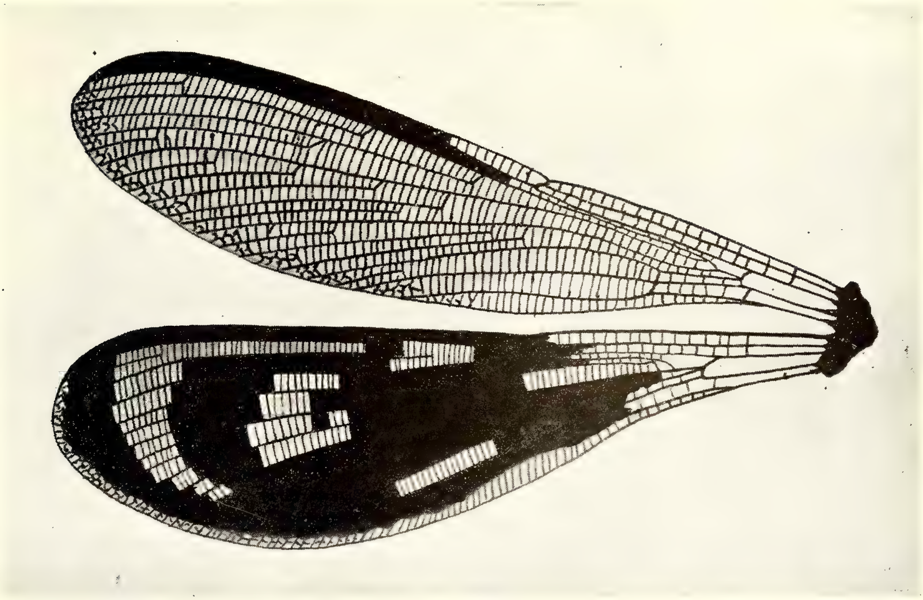


FIG. 1

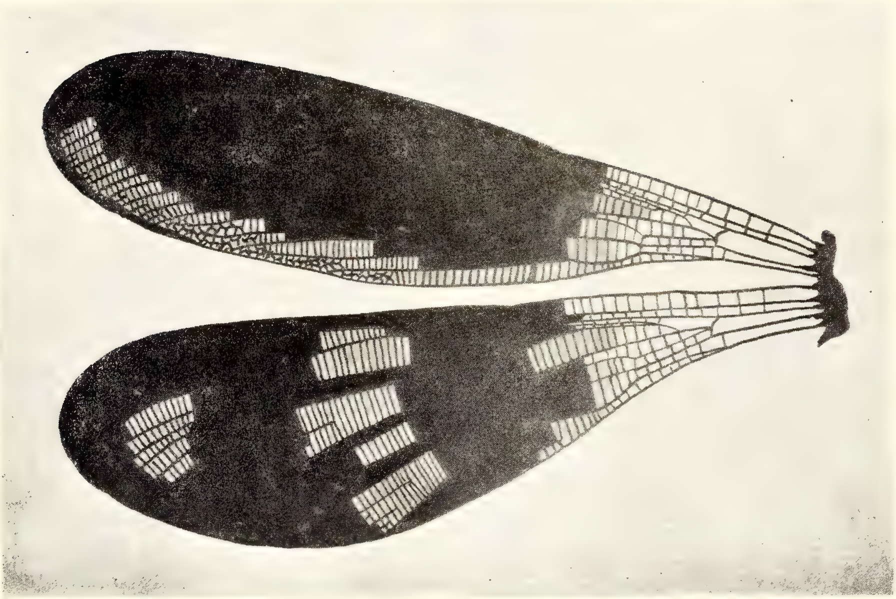


FIG. 2

FIG. 1. WINGS OF *Rhinocypha iridea* SELYS., MALE

FIG. 2. WINGS OF *Rhinocypha fenestrella*, RAMB., MALE

The black areas are steely blue or dark green, the shaded areas are vitrified and glow with peacock blue, gold, green or violet reflex according to the angle from which viewed.

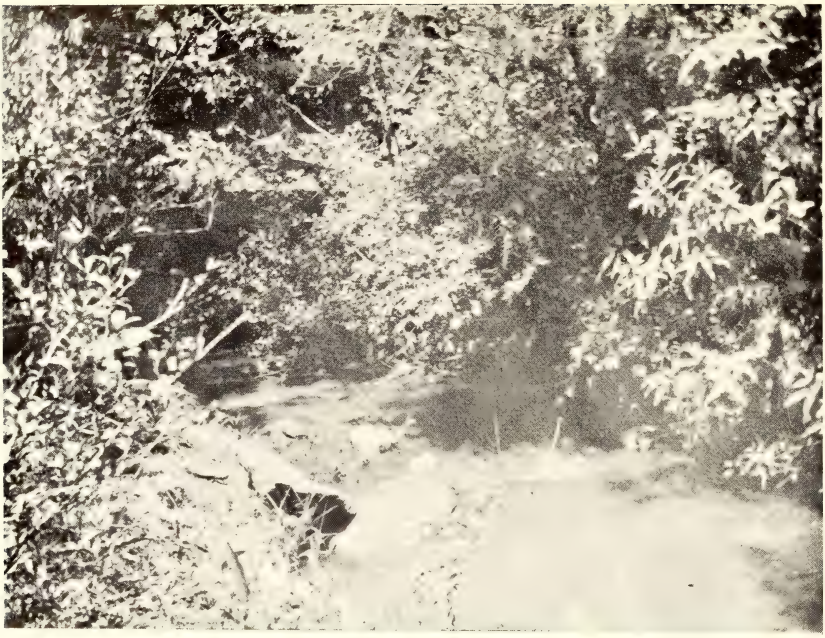


FIG. 1. VIEW OF ROCKY BED OF A MONTANE STREAM IN SHILLONG, ASSAM, WHERE *Rhinocypha ignipennis* AND *spuria* ARE FOUND. OTHER ZYGOPTERA TAKEN HERE ARE *Matrona basilaris* AND *Echo margarita*.

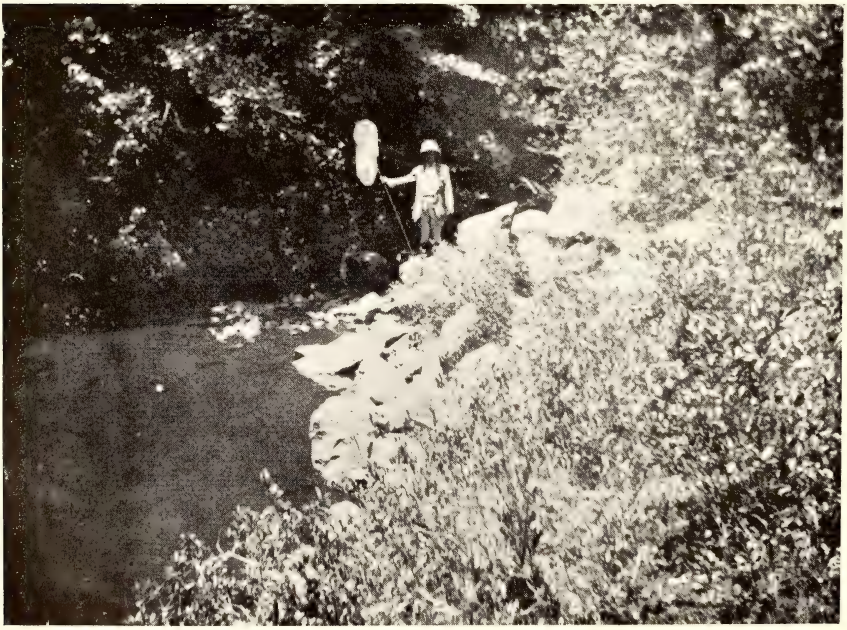


FIG. 2. ANOTHER TYPICAL STREAM FOR *Rhinocypha ignipennis*. Pool below Seven Falls, Shillong, Assam.
(*Photos taken by Mr. Bainbrigge Fletcher.*)

Rhinocypha iridea, Selys., Ann. Mus. civ. Genov. (2) x (xxx), pp. 492-494, (1891); Will. Proc. U. S. Nat. Hist. Mus., vol. xxviii, pp. 173, 181 (1904); Laid. Rec. Ind. Mus., vol. xiii, p. 37 (1917).

Male. Abdomen 20-22 mm. Hindwing 25-26 mm.

Head velvety black marked with yellow as follows :—a small spot on the outer side of each posterior ocellus, a rounded spot on each side of the occiput and an oval spot on the posterior border at its centre. Labium black, the basal halves of the middle and lateral lobes yellowish white. Bases of mandibles bluish ; labrum with a broad transverse stripe pale blue, indented by a small prolongation of the basal black in the midline.

Prothorax black marked with azure blue as follows :—a medial, longitudinal stripe on the posterior lobe, a large lateral spot on each side of the middle lobe and a small spot at the outer angle of the posterior lobe. In teneral specimens, these markings yellowish, the hinder margin of the posterior lobe being narrowly yellow.

Thorax black marked with azure blue as follows :—a fine antehumeral stripe, curved outwardly above, expanding slightly below, an equally narrow humeral line lying along the hinder border of the humeral suture, a similar line adjacent to the first lateral suture, a broad oblique stripe on the hinder half of the mesepimeron not extending to the root of wings and broadening abruptly and markedly on the lower half of the mesepimeron. Finally the whole central part of the metepimeron.

Legs black, the two hinder pairs of tibiæ and distal two-thirds of the same femora densely pruinosed white.

Wings partly opaque, the hind distinctly broader than the fore. Forewings hyaline at base, vitreous towards the apex, the costa for a depth of two cell-rows opaque black as far as 10-12 cells distad to node, behind which the wings glow with an iridescence of many colours according to the angle from which viewed. The extreme apex is dull violaceous, the greater part of the wing golden green as far proximad as the node. The opaque area along the costa often extends nearer the node in the space between *Ri* and *Rii*, than between the costa and *Ri*. In the hindwing, the opaque area extends irregularly in as far as the middle of discoidal cell at that level, and for about 3 cells proximad of node along the costa. This area marked by vitreous spots and stripes as follows :—an elongate sickle-shaped stripe made up of a single row of cells, margined costalwards by *Rii* and beginning about 15 cells distad of the node, it extends distad to the level of middle of pterostigma at which point it turns down in a regular sickle-shaped curve. This end of the stripe made up of 12 rows of cells, broad at the costal end, tapering towards the hinder border of wing, which it nearly meets. The costal end of this curved stripe nearly continuous with an elongate spot which lies in the angle formed by *Rii* and *Riii* at the subnode, and which is about 18 cells long. Lying within the angle or curve formed by the curved band is another vitreous spot, which lies between *IRii* and *Riv + v*, is irregularly quadrate and very broken and jagged on its inner and outer borders. Immediately posterior to the first spot is a third, separated from it by 4 rows of cells and bordered behind by *Cuii*, equal in length to the subnodal spot. The whole posterior border of wings from the nervure *ac* to the outer end of *Ri* narrowly vitrified and hyaline. Finally an elongate spot which begins adjacent to the arc, bordered behind by *Riv + v*, and extending distad into the opaque area for a distance of about 18 cells. The sickle-shaped band and the border of wing glow golden green, the spots rose pink or purple or emerald green according to the angle from which viewed. Pterostigma black, yellow outwardly.

Abdomen black marked as follows with azure blue :—a triangular spot on each side of segment 1 and its apical border, an elongate spot and an apical point on each side of segments 2 and 3, the long spot abbreviated on 2, long and tapering to a point on 3, segments 4 to 8 with the elongate spot only.

Anal appendages similar to those of *Cuneata*.

(This description differs in several points to the original Selysian one, which was made from a sub-adult specimen. Thus the markings of the labrum, prothorax and thorax are given by Selys as yellow instead of azure blue. In this species, probably better than in any other known dragonfly, one sees the gradual development of colour, especially in the wing markings which develop gradually in the course of several days like the details of a developing photograph. Mature specimens are comparatively rare in collections, most showing a thin greyish marking like an insufficiently exposed and under developed photograph. The fully adult insect is probably the most beautiful insect in the world, if one considers the combinations and harmony of colouring, together with the delicacy and artistic nature of the design in the hindwings.)

Female. Abdomen 20 mm. Hindwing 28 mm.

Head black marked with yellow spots as follows :—similar spots as found in the male, and in addition, a large rounded spot on summit of epistome, obsolete in adults, the bases of mandibles, a triangular spot on each side the epistome, two large subtriangular spots on the upper surface of frons, an oval spot on each side of the anterior ocillus, and lastly the cheeks narrowly. The middle and lateral lobe of labium yellowish white except the extreme tips.

Prothorax and thorax similar to the male but the mesothoracic triangle outlined in yellow instead of pink, and the markings more of a greenish yellow instead of blue.

Legs black, tibiæ and femora pruinosed white on flexor surfaces.

Wings entirely hyaline, tinted with greenish yellow ; pterostigma framed narrowly in black, clouded with blackish inwardly, yellow outwardly ; 14–15 antenodal nervures ; discoidal cell traversed 3–4 times in both sexes.

Abdomen black marked with azure blue as in the male, but the spots confluent to form a single stripe on segments 1 to 4, and segments 8 and 9 with an apical lateral spot. Segment 3 with a ventral stripe.

Anal appendages and vulvar scale similar to *cuneata*.

Distribution. Upper Burma only. Type in the Selysian collection, Brussels Museum, from Leito. It occurs from May to August at Maymyo, S. Shan States, Upper Burma, where Col. F. Wall found it comparatively common. Paratypes in the B.M., Pusa Museum, etc. The species is related to group *unimaculata* by the primitive condition of its mesothoracic triangle, which resembles that of the female.

(*To be continued*)

REVIEWS

1. A NATURALIST IN EAST AFRICA. By G. D. Hale Carpenter, D.M. (Oxon.), M.BE., Oxford University Press, 1925. Price 15*s*. 187 pages. Illustrations, Map and 7 Plates.

We have read Dr. G. D. Hale Carpenter's latest work with interest and can unhesitatingly record the opinion that it is a worthy successor to his *A Naturalist on Lake Victoria*.

Although primarily an entomologist the author finds plenty of time for the meticulous study of the fauna and flora in general with which he comes in contact, and many of his observations are of the greatest value.

The volume under review deals principally with insect colouration and mimicry described from various view points, but there is much else of absorbing interest to the field and scientific naturalist, and the subject matter, though in reality highly technical, is set forth in such pleasing fashion that it at once becomes acceptable to all.

Dr. Carpenter draws attention to a distinct link between Africa and America and quotes how he had the good fortune in Portuguese East Africa to procure a specimen of an exceedingly rare African Earth Snake belonging to a South American genus. He also instances certain snakes and day-flying moths which furnish interesting links between the two great Ethiopian and Neotropical areas.

The author has introduced a subject of the utmost importance, which has as yet received but scant attention from the field naturalist and scientist alike.

Much can be learnt about the past from the distribution of the flora and fauna of the present—much more than one is apt to realize. The picturesque photographs and carefully prepared plates are a welcome portion of the book a copy of which should be in the hands of every naturalist in Africa and we congratulate the writer on its general excellence.

It speaks volumes in favour of having a hobby, especially in tropical countries and still more so in time of war, and we hope that this work will be the means of inducing many others to take up natural science pursuits.

We have one quarrel with Dr. Carpenter and that is his use of an English nickname for a common African bird. ' Paddy-Bird ' sounds extraordinarily out of place in a book of this class and is, we understand, used in reference to *Bubulcus ibis* (the Cattle Egret). Confusion is apt to arise from such nomenclature for the ' Paddy-Bird ' or ' Pond-Heron ' of Asia is also found in East Africa and Uganda.

We can visualize the author's horror at the use of the word ' Iguana ' for *Varanus niloticus* (the Nile Monitor), so the ornithologist may well be forgiven his momentary shudder at the expression ' Paddy-Bird.'

C. R. S. P.

2. NOVITATES MACROLEPIDOPTEROLOGICÆ. By Otto Bang-Haas. Published in German by Dr. O. Standinger and A. Bang-Haas of Dresden Blasewitz, Volume I. (Price 15*s*., 9 × 6. xx. plus 238 pages.)

A catalogue of Palæarctic macrolepidoptera described since the publication in 1907 of Seitz ' Macrolepidoptera of the World ', Palæarctic section, up to the year 1920. Volume II will deal with 1921–23 and Volume III with 1924–26 ; subsequent volumes will be issued as time goes on. The catalogue is arranged exactly in accordance with Seitz's work and for each new species, etc., described it gives the reference to the publication and the locality.

In the introduction the author admits that the Zoological Record furnishes year by year a list of all new names, but he does not like the arrangement, finds it incomplete, inaccurate and that localities are omitted. He acknowledges that all collectors and students owe a great debt to Dr. Seitz for his great work and since no revision or similar publication is likely to be issued for at least a generation, he considers that the keeping it up to date by the means he has adopted is a necessity.

He comments on the multitude of names now possessed by the better known species under the designation of pro-species, super-species, vice-species, sub-species, geographical races, generations, varieties, mutations, forms, aberrations, modifications, hybrids, etc., and the consequent chaos as far as the collector is concerned. For instance *Parnassius apollo* had eight names in 1901 and now has 400.

He points out the difficulties attendant upon the making of a catalogue of this nature and how greatly the work would be facilitated, if every author would draw particular attention to the new names he had coined and describe the locality of the type specimen, so that it could be found easily on an ordinary map. In separates the publication wherefrom taken should be clearly specified and the original paying used.

The catalogues will be of the greatest assistance to systematic workers and their use may prevent to some extent the manufacture of new names, which for butterflies has assumed alarming proportions of late : in fact it is degenerating into stamp collecting and the truly scientific aspect is becoming obscured. Doubtless in years to come the League of Nations will take the matter up.

The catalogue is by no means free from errors ; a cursory glance has revealed the following amongst others :—

Page 76. *Ilerda viridis* is given as from Thibet : it should be Eastern Himalayas.

Page 91. *Lycæna orbitulus walli* is given from Thibet : it should be Chitral.

It is a pity that the author could not take in a little more of India into his Palæarctic zone : he gives North India as a locality in several cases, but he omits butterflies described from Kumaon, the Naga Hills, etc., where the Palæarctic elements are very pronounced. An improvement suggested for future volumes is to draw attention to specific names by setting them towards the margin, underlining or bolder printing.

W. H. E.

EDITORIAL.

GAME PRESERVATION.

We should like to bring to the notice of members the work of the Society for the Preservation of the Fauna of the Empire. The Society was formed in 1903 by the late Mr. E. N. Buxton and a number of fellow nature lovers with the main object of awakening public interest in the wonderful assemblage of wild fauna which still survives in many of the dominions and colonies of the Empire and of taking such steps as were possible to save them and also some of the rarer indigenous fauna of the British Isles.

The ideals of the Society are to impress upon every colony and dominion in the Empire the vital need of taking measures to ensure that the wonderful fauna of the lands which constitute the British Empire shall not be destroyed. It forms no part of the Society's programme to interfere with legitimate sport or to obstruct economic development, neither of these things being incompatible with the permanent existence of wild life. All that the Society desires to ensure is that beautiful and rare species of living creatures shall, so far as possible, be saved from extermination with which, owing to ruthless exploitation for personal gain and wholesale destruction by ignorant persons frequently equipped with all the latest resources of civilization, many of them are threatened to-day.

One of the main objects of the Society is the establishment of game sanctuaries in every dominion or colony where the fauna indigenous to the country can live in restricted freedom. To attain this goal the Society desires to make its membership as wide and as influential as possible and therefore appeals to all who may be in sympathy with the preservation of wild life whether at home or abroad to join its ranks. We feel certain that there are many of the readers of this journal who are in sympathy with the objects and purposes of this Society for the Preservation of the Fauna of the Empire and would be willing to assist it in carrying out its aims and purposes by joining its ranks. The minimum subscription is 10 *sh.* but it is hoped that those who feel that they are able to do so will subscribe a larger amount. Communications from those who intend to join, should be addressed to the Secretary, Society for the Preservation of the Fauna of the Empire, c/o Zoological Society of London, Regents Park, London, N. W. 8.

AGRICULTURAL RESEARCH.

The Agricultural Research Institute, Pusa, held an important place in the deliberations of the Royal Commission on Agriculture which recently toured India. We feel certain that much of the criticism levelled against the Department would be silenced if its labours were more fully known and received the publicity they merit. The recently published Scientific Reports of the Institute are an illuminating record of the work accomplished in various sections of the Imperial Institute of Agriculture. The improvement of the wheat and other cereal crops of India has occupied much of the attention of the Botanical Section of the Institute and practical evidence of the work is seen in the good yields of Pusa wheat in the Central and United Provinces and the extension of the distribution of these famous wheats to Bihar and Orissa. Trials with imported tobacco varieties have also been successful, and with suitable curing methods the possibility of producing cigarette tobacco in Bihar suitable for the overseas market is within reach. Other beneficial activities of the Institute include experimental work on the nature of soils and manures and the attacking of such practical problems as diseases of leguminous crops, sugarcane, and cotton and on the most effective methods of controlling serious insect pests. The efforts of the Department to improve the yield and quality of Indian milch cattle will meet with general approval. The policy now being adopted is to cross the half-bred Ayrshire-Sahiwal cows with pure Sahiwal bulls in order to adapt the imported Ayrshire milking strain to the needs of the country. The milk yield per lactation period of 300 days of 16 cows in the half-bred Ayrshire-Sahiwal herd was over 6,000 lbs. Very important and valuable experiments on the nutrition of growing animals and the nutritive value of Indian coarse fodders were carried out by the Physiological Chemist at Bangalore. One important phase of the activities of the Institute is the provision of facilities for training Indian students in different branches of Agricultural Science at Pusa and at Bangalore. That an extension of this side of the work of the Imperial department is urgently required is seen in the evidence given by Mr. Bainbrigge Fletcher, Imperial Entomologist, before the Agricultural Commission. Mr. Fletcher emphasised that research work in Entomology should be carried out by a properly organised and centralised Entomological Institute. He showed that the total losses caused by insect pests in India could be estimated at the enormous total of 200 crores of rupees. The main need for the moment is more skilled workers and greater co-operation between workers. Mr. Fletcher referred to the inadequacy of the two years' course of training at Pusa and added that if training to the Imperial Service standard was to be given, a proper teaching staff must be provided. Entomology must be considered as a whole and entomology as applied to Agriculture could not be divorced from Entomology as applied to forestry, medical and veterinary work. Mr. Fletcher was of opinion that a proper course for training in Entomology should be so arranged as to give the student a general course in this subject for two or three years after which he could specialise in any special or particular phase of the subject. In Biological work it is the man who counts far more than any training and, unfortunately, the supply of really keen entomological workers is practically non-existent in India.

WOLF CHILDREN.

From time to time reports appear in the Press regarding the finding of human children in the lairs of wolves, living amicably side by side with their foster brothers and sisters—the wolf cubs—and being fed and tended by the parent wolves. The theme is of great antiquity : it recalls the celebrated 'Twin Brethren,' and has enjoyed credence through many ages.

Two stories of this nature have made their appearance before the public in the course of the last few months. One relates to two aboriginal girls, 2 and 8 years old respectively, who were found in a wolf's den at Midnapore, West Bengal. Bishop H. Pakenham Walsh, whose private letter on the subject was quoted by the newspapers, when written to for further particulars of the case, informs us that the Rev. Mr. Singh, (who according to the press report was present on the occasion of the digging out of the children from the lair,) only had the children given him by one of the rescue party a fortnight afterwards who also told him their story. The Bishop writes to say that Mr. Singh has photos of the children taken at various times after their recovery and he intends to write a book on the subject later, but to obviate the troubles of notoriety, he does not wish, in the interests of the children, to divulge anything further at this stage.

Evidently no clue is available to indicate the length of time the children had been with the wolves, but from Mr. Singh's statement that the girls had acquired animal habits, such as sitting down like quadrupeds, taking no food or drink without first smelling it, finding their food by smell, rolling their eyeballs and moving their jaws from side to side making a peculiar sound with tongue and teeth, would go to show that they had lived in these surroundings for some considerable time. This being the case, it is very probable that the younger girl was added to the lupine household at a later date, as we are told she was only about two when rescued. If it be assumed that both the children had been carried off simultaneously and had been with the wolves for a year or a year and a half, it would hardly account for the elder girl acquiring the canine habits to such perfection within so short a time, considering that she must have been 6½ or 7 years old at the time of adoption by the wolves.

Since the appearance of this report, there has been a good deal of correspondence and some controversy on the subject through the press. One physician argued that it would be physically impossible for a human child to subsist on an exclusive raw meat diet which is presumably what the foster parents fed them on.

Whatever the merits of this argument, the fact that human children have repeatedly been found in the lairs of wolves must be faced, and it seems difficult to imagine that the foster parents could feed the children on anything but the food they gave to their own cubs—i.e. raw meat—often regurgitated. The question arises, can human children subsist on such a diet? If the answer is in the negative how can one explain the persistent recurrence of reports of this nature?

It must be owned, however, that stories like the above are rarely based on reliable first hand evidence, and most of them gather such proportions as they are 'passed down the line' as to cast reflections on even the few verified instances on record.

On page 142 of Volume IV of the Society's Journal will be found a very interesting account of a wolf-boy by Shams-ul-ulema Dr. Jivanji Jamshedji Modi and a reference to two other reliable instances of a like nature which were recorded in the Proceedings of the Asiatic Society of Bengal for 1875.

Still more extraordinary is the case reported by Mr. E. C. Stuart Baker in Volume XXVII, page 117 of this journal where he relates the incident of a child that had presumably spent three years of its life in a leopard's den. When seen by the author of the note the child exhibited many distinctly animal-like traits—squatting like an animal, putting his head in the air and sniffing about, bolting on all fours and when frightened backing 'like a small wild beast returning into its burrow'. According to the history of the case—as reported by the father of the child—the baby had been carried off by a female leopard whose cubs had been killed by villagers; attempts to recover the child were unavailing but three years later a female leopard was killed in the vicinity and two cubs, together with the child, were captured by the villagers in her lair. The child was at once identified by the parents and their claim admitted by the whole village.

A Biarritz paper recently published an interview with Mr. Rudyard Kipling where commenting on the recent discovery of a wolf child in India, he said, 'It is by no means impossible and there have been other instances of it already.' 'But they say,' continued Mr. Kipling, 'that the child crawls on the knees and hands. I think it would be much more likely that it would be on the knees and elbows, for that was the way of the other children like Mowgli who were adopted by wolves and knew all the mysteries of the jungle, so that their hands were free to seize their prey or defend themselves.'

It may not be generally known that Mowgli—famed far and wide through the Jungle Book—was a living individual and not merely a product of Mr. Kipling's imagination. According to the version of Mr. B. Ribbentrop, the lad, after he was reclaimed from the 'jungle log,' came under the notice of Mr. Ribbentrop's father during the latter's Inspector-Generalship of Forests in India, who was so struck with the boy's almost uncanny knowledge of jungle life and lore that he straightway appointed him a forest guard. We wrote to Mr. A. Rodger, the present Inspector-General, for corroboration and he very kindly caused a search to be made in the departmental records of the Central Provinces, but unfortunately without success.

Such stories always give rise to a great many difficulties and there is a line of argument, which compels one to a conclusively negative verdict! For instance, why is it that a monkey caught soon after birth and living the whole of his life among human beings without perhaps seeing another monkey during its life time, never learns to walk and behave like a human being, while, on the other hand, a human child reared, even for a comparatively short period, by wolves, in every known case has acquired the methods of progression and behaviour of its foster parents!

We should be very happy to hear of any first hand records our readers may be in possession of.

POONA NATURE STUDY CLUB.

We have just received the first number of a magazine entitled 'Out-of-Doors' issued by the above club.

The club was started in July 1924 mainly through the initiative of Miss Payne, Inspectress of Girls' Schools, and we welcome its decision to publish its magazine which was considered essential 'to keep the club together and to make certain of its healthy development.'

The magazine is intended for recording the doings at rambles and meetings, for publishing observations and questions of members and for furnishing a means for members bringing to the notice of others, literature and methods in Nature Study. It is to be run on popular and not technical lines which is in our opinion one of its greatest attractions.

Popular Nature literature is sorely lacking in this country, a country which has been especially endowed by Nature with superabundant material for study, and we hope the good example of the Poona Nature Study Club will be followed by towns and cities all over the country. There never can be a glut in the ranks of such clubs and it can be said of them with more aptness than of many another institution that the more we have of them the merrier. More members are wanted by the Poona Club, and we would recommend all interested in the subject to communicate with the Honorary Secretary, Miss Fielding, High School for Girls, Huzur Paga, Poona City.

THE GAME BIRD BOOKS IN MONTHLY PARTS.

In our last editorial we referred to the need of popular books on Natural History and the publication in the near future of the 'Book of Indian Birds' which we propose issuing on the lines of the book on American Birds issued by the Geographical Society of America. The popularity of the book seems assured because it appeals to the many and will be cheap. There are other publications of the Society which appeal to the many but which are not popular because they are not cheap. We refer to the Game Birds of India series by Stuart Baker. Taking the first and second editions of the first volume—that on Indian Ducks—there are at present some 1181 copies reposing in Mess, Club and private libraries and there are 319 copies awaiting sale—of the second volume on Woodcock, Snipe, Bustards and Sandgrouse, 747 copies have been sold and 353 are awaiting sale. Is it to be wondered at that the Committee say 'We must sell more copies of the first two volumes before we publish the third'? But members of the Society who have the first two volumes are if not turbulent at least clamorous. If they want a thing they say so and amongst the clamorous ones, there are also those with ideas. The first two volumes are not selling, not because they are not wanted but because their capital value is too high. Many a man will buy a £1 share and increase his holding to £100 who would never have invested a penny had the share been £25.

So it is they say with our Game Bird books—bring out volume iii (Pheasants) in monthly parts, each with a plate, and when the parts are all issued issue a binding cover. The cost of each part will be within the purse of all. Some can buy outright and get benefit by doing so. But bring the Game Books within the reach of the many by reason of its price and you will obtain subscribers.

The idea has merits and has possibilities. In fixing the price not only would a concession be given to members but a concession would be given to those who owned Volumes 1 and 2 of the Game books.

We will imagine that the published price of the bound third Volume is £3-10-0 and that it is also brought out in 12 monthly parts at Rs. 4-0-0 per part. Very well, the member of the Society who has not got the previous books pays £3-0-0 for the bound third volume. He pays £2-10-0 if he has one of the two previous volumes and £2-0-0 if he has both. The monthly parts are only to be sold to members. If they are not owners, or do not become owners of either of the previous volumes they pay Rs. 4-0-0 per part. If they own one volume they pay Rs. 3-8-0 per part. If both Rs. 3-0-0 per part, or with binding say Rs. 45-0-0 in instalments. Does it appeal or is it too commercial? Does it sound too much of the Encyclopædia? It is in the interest of members themselves. We must translate our dead stock of books into the live stock of Government paper. If members wont have them, we, unfortunately know who will and that is the Termite. Termites have already got through one tin lined case and destroyed £100 worth of volumes. Well there is the suggestion and we shall be glad to have the opinion of members on it. The third volume of the Game Bird series which we propose to issue in parts will deal with Pheasants, Jungle fowl and Spur fowl and contain sixteen coloured plates and six black and white plates. The fourth volume will deal with the Partridges and Quails. The letterpress of the above volumes first appeared in Volume XXIII No. 4 of this Journal and concluded in Volume XXX No. 2. A series of articles on the Waders and other semi-sporting birds is now in course of publication and will comprise when concluded the fifth volume of the series.

A PROBABLE CHANGE IN THE CONSTITUTION OF THE SOCIETY.

The Society as at present constituted, or rather unconstituted, suffers from several disabilities especially where the holding of property—whether or no in the form of Government securities—is concerned. The Committee have under consideration therefore the registration of the Society under the Act for the registration of Scientific Societies of 1860. The various clauses in the articles of Association have to be carefully considered and care taken that nothing is left out which ought to go in and nothing put in which, except for the lawyers' fees for getting repealed, would be the better left out.

One problem is the Rule and Governance of the Society. Every member who can record a vote has a right to vote for the Committee of Management and certainly all in India and Burma should be able to vote. The Committee of Management should however be composed of those who can meet together and discuss matters in person. This looks as though the Committee of Management must be composed of those who live within two hundred miles of Bombay and there will have to be—or it will be of advantage for there to be—an Advisory Committee of members from the Mofussil (Dare we include Calcutta and Madras within that word? We admit they are not mofussilites but they, like dwellers in Dusteypur, have not the good fortune to be Bombayites!) We shall thus still retain the useful services of many old friends. The proposals will in due time be sent to each member and amendments considered. There is one change which we do not anticipate any one will wish to make. The Society is not a Society of Bombay Naturalists (there are far too few of them). It is a Society of men and women studded over the face of India, Burma, Ceylon and many other countries, all working for the improvement of our knowledge of the fauna and flora of the Oriental region, but the Society started in Bombay and it has made the name of the Bombay Natural History Society well spoken of throughout the world. Let its maiden name remain unchanged even though it be wedded to the law.

THE DEHRA DUN FISHING ASSOCIATION.

In our last editorial we referred to the work of the Dehra Dun Fishing Association and published a request made by that Association to all interested in angling.

The Honorary Secretary is athirst for more information. The scales of the Salmon haye been a mine of information to students of their life-history. Why should not the scales of the Mahseer also yield valuable information? He writes :—

'I recently read an article in one of the monthly Magazines (Pearson's) 'on "Solving the riddles of the Sea" and, *inter alia,* there was a section dealing 'with the markings on the scales of Salmon, by which its age, and almost 'its life history could be ascertained.

'It occurred to me that possibly the same could be done in the case of 'Mahseer. Accordingly I send you a scale of a Mahseer caught on 10th April, '1927 for favour of any information you can give me on the subject. The 'fish from which it was taken, weighed 2 lbs., dry, and its probable weight, 'wet, would be 2¼ lbs. Its length *over all* was 1 ft. 6 in. and to the fork of 'the tail 1 ft. 4½ in. Its girth, dry, was 8½ inches (probably about 9 inches 'wet). The weight does not conform to Thomas's rule that the Mahseer's 'weight is the *cube* of the length *in feet* from the snout to the fork. The rule 'does not take into consideration the condition of the fish and there should, 'I think, be a girth factor.

'On the scale sent, I can decipher only *one* ring, though under a magnifier two or more may be discovered.

'I propose keeping a record for a short while of various weights and sizes 'of fish and their scales to see if any information can be obtained regarding 'the relation of weight and age.

'Any hints in this connection would be thankfully received.'

ACKNOWLEDGMENTS.

Our acknowledgments are due to Major G. T. Fisher H. B. M.'s Consul at Seistan and to the British Vice Consul at Birjand for the very great assistance that they have afforded to V. S. LaPersonne, our collector, during his collecting expedition in Persia. Mr. LaPersonne has been in Persia since September where he has done good work; unfortunately in February this year he met with an accident which resulted in a broken left arm which was followed up by an attack of malaria. The British Vice Consul at Birjand to whom we cabled in reference to LaPersonne's illness replied that 'There would be no medical charges as Mr. LaPersonne was his guest.' Practical assistance of this nature is both helpful and encouraging and on behalf of the Committee we extend our thanks to this gentleman for his generous aid to our collector.

OBITUARY.

EDWARD MAXWELL WEST.

We much regret recording the death of one of our members and an appreciated contributor to this journal, Capt. Edward Maxwell West of the 2/3 Queen Alexandra's Own Gurkha Rifles who was killed by the Kachins whilst on a Government mission in connection with the suppression of slavery in what is known as the Triangle in Upper Burma.

We echo the words of the Government of Burma Despatch 'The Governor in Council greatly regrets that one of the parties emancipating slaves has been attacked and that Capt. West, a very gallant officer, a Lance Naik, Agam Singh and one follower have been killed, three wounded and a civil interpreter reported missing.

It appears that Capt. West who was with an advance party was treacherously betrayed by two sons of the Chief of Nankhum, who were acting as guides, into an ambush of some 50 Kachins armed with muzzle loading guns, who opened fire killing Capt. West on the spot. Capt. West was buried at Kritaw, apparently some 14 miles south-east of Punbhum the military police outpost on the west of the river.

Capt. West's article on Takin Shooting which appeared in Volume XXXI No. 2 had made us look forward to many more articles by the same pen, and his untimely death is our very great misfortune.

ANGUS PETER KINLOCH.

Mr. A. P. Kinloch joined the Natural History Society in the year 1912. He was an enthusiastic naturalist and a keen contributor to the pages of this journal.

Among the articles which have appeared under his name are the following :—

- Rough notes on the Avifauna of the Nelliampathy Hills, vol. xxvii, p. 939.
- The Avifauna of the Nelliampathy Hills, vol. xxviii, p. 279.
- The Large Mammals of the Nelliampathy Hills, vol. xxix, p. 552.
- On the Birds of Nelliampathy Hills, vol. xxix, p. 564.
- The Nilgiri Tahr, vol. xxxi, No 2.

Mr. Kinloch was also of great service to the Society during the Mammal Survey and was always ready to render assistance to our collectors in the field.

In an editorial published in No. 4, Volume XXVII we made a reference to the death of his father, the late Mr. A. M. Kinloch, also a very keen naturalist, who met his death while hunting, having been killed by a wild boar which he had wounded and followed through the scrub, and we have now, with regret, to record the death of his son. Mr. A. P. Kinloch died at Seetagundy Estate, Nelliampathy Hills, Malabar, S. India, on the 10th February, 1927, from heart failure.

Angus Peter Airlie Hamilton Kinloch, age 31, was the son of the late Mr. A. M. Kinloch and grandson of Major-General A. A. A. Kinloch. Mr. A. P. Kinloch was a fellow of the Zoological Society, and a member of the B. O. U. He served in France in the Great War with distinction, being wounded twice, from the effects of which he suffered up to the time of his death.

He was a very keen naturalist, a good planter and a very hard worker, and his death is regretted by a very wide circle of friends.

MISCELLANEOUS NOTES

I.—OBSERVATIONS ON THE HABITS OF THE SLOW LORIS *LORIS LYDEKKERIANUS*

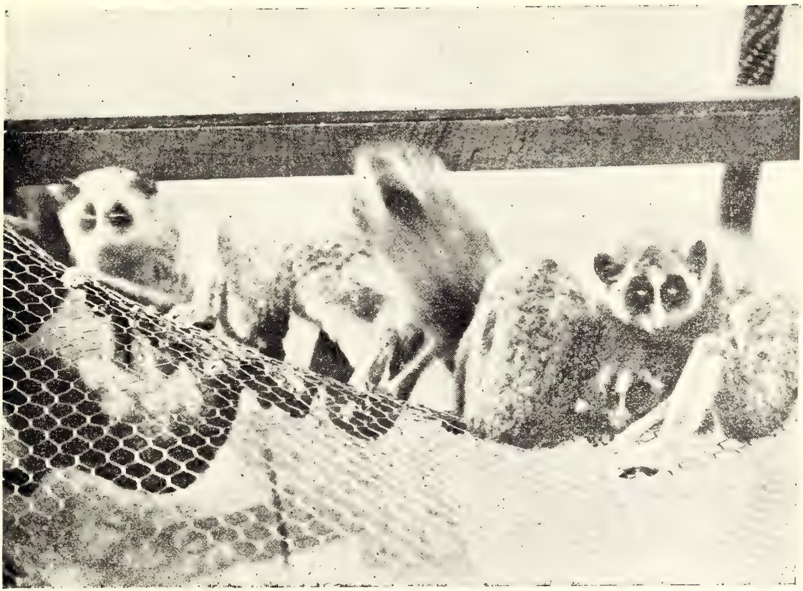
(*Reprinted from the Mysore University Journal, Vol. I, No. 1, January, 1927*)

(*With a plate*)

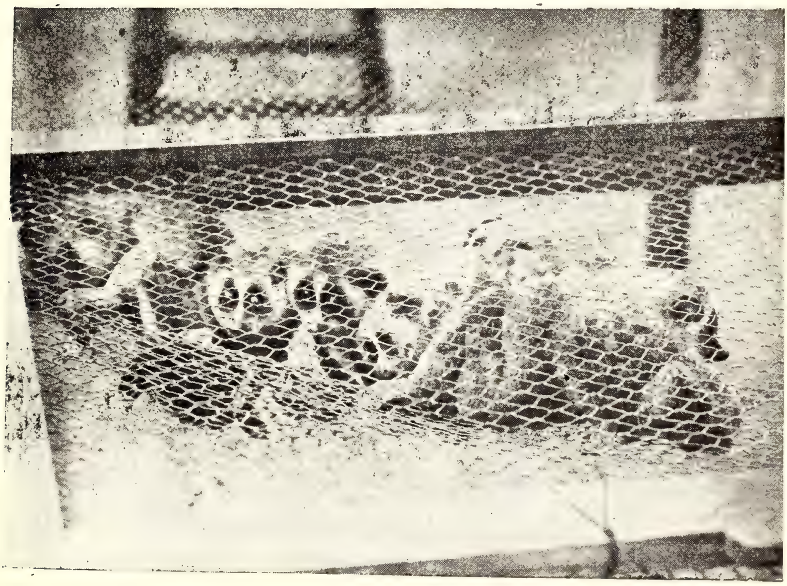
The South Indian Slender Loris, formerly described under the name *Loris gracilis*, is now recognized as comprehending two distinct species which have been named *L. lydekkerianus* (the Mysore Loris) and *L. malabaricus* (the Malabar Loris). Sometime ago, a large number of the local form were kept in captivity for long periods of time and it occurred to the present writer that most of their habits, which are practically unknown to the zoologists on account of the exclusively nocturnal mode of life adopted by them, might possess great interest in several particulars.

Two cages, $5\frac{3}{4}' \times 3' \times 2'$ and $4' \times 3' \times 3'$, with wire netting all round and above, were provided, and branches of suitable size stripped of leaves were planted in the centre. They were placed in a dark and less frequented portion of the laboratory, thus securing for the animals as far as practicable the conditions of their natural environment.

In nature, these prosimiæ are not colonial in the sense that the members of the genus *Macacus* are, and we find them leading almost a solitary life; occasionally a male is found in company of the female on the same branch. They invariably select shady, inaccessible recesses in the trees and spend the day in profound sleep with the head and hands tucked well under the abdomen,—an attitude not unlike that of the fœtus in the uterine chambers. I have never discovered them suspended from the trees in nature, though in confinement they are occasionally found hanging from wire-netting or branches in sloth-like fashion for a short time and as soon as they are freed from disturbance, they double up in corners. They are heavy sleepers and at the same time are extraordinarily wary. On the approach of man, the little creatures slowly elevate their heads, cautiously look round, and stare wildly, climbing up the terminal twigs whence they are dropped by long poles. Capturing them is by no means easy, for, if in the course of their involuntary descent, they touch another branch, they simply glide over to the next tree and entirely vanish from sight. The trees they most affect are the peepul, mango and tamarind whose barks their fur resembles so closely that the animals nearly escape detection from a distance. In the nights they leave their hiding places under dense foliage or holes and fissures in the stems and enter the lantana bushes of whose berries they are passionately fond, and when thus browsing, it is out of the question to capture them. They eat nearly every fruit with a hard rind, but in confinement they have steadfastly declined to touch potato, sweet potato, fresh and cooked; they would, however, greedily devour plantains, cooked rice and milk. Eggs broken and entire, minced meat and insects like grass-hoppers and beetles do not attract them. No doubt the dentition of these primitive creatures is usually described as insectivorous, chiefly because of the comb-like lower incisor teeth and the sharp projecting cusps on the pre-molars and the molars. The dental formula is I $\frac{2}{2}$, C $\frac{1}{1}$, P.M. $\frac{3}{3}$, M $\frac{3}{3} = 36$, certainly a more generous allowance than is allowed to the other South Indian monkeys. The upper incisors are vestigial and are rounded at the tips, besides being separated medially by a wide gap. The lower incisors point forward, which the lower canines resemble. When the jaws are pressed together, it is noticed that the incisors do not meet at all and under these circumstances it is really difficult to imagine how these teeth can be employed for crushing the hard horny investments of beetles on which they are reported to feed. Nor is the statement of Blanford that these prosimiæ find all the food on the trees they affect,—birds, birds' eggs, lizards and insects,—quite correct, for they have been noticed to change their habitation as often as they descend to the ground for the purpose



IN EXPECTATION OF THE EVENING MEAL.



ALL HUDDLED TOGETHER IN A CORNER OF THE CAGE
(*Miscellaneous Note No. I.*)

of feeding, and it is my experience that none of the animals, which are said to form part of their food, excite the least interest. The sharp cutting cones on the grinding teeth might suggest a carnivorous diet and indeed the modification has gone so far that the first pre-molar of the lower series assumes the form and proportions of the upper canines against which it abuts. But the most extraordinary feature of the feeding habits of these animals is that they become so perverse in their tastes that they develop cannibalistic instincts in the presence of a dead companion of theirs. The soft snout, eyes, the external genitalia and other bare portions of the body are greedily devoured and still more puzzling is the fact that the female, totally devoid of maternal impulses, may be found making a meal off her own dead offspiring. In this respect these prosimiæ are totally opposed to the common female monkeys which are frequently observed to carry fondly in their hands their lifeless babies though in an advanced state of putrefaction. It seems to me that the real explanation of this debased character does not lie in the theory that these animals, normally carnivorous, develop cannibalism in captivity, but on the other hand, it is an expression of their mutually exclusive antipathies and jealousies which are avenged after death. In support of this view I might instance that after severe fights among the males which sometimes terminate fatally, the victor pursues his vengeance even after death by quietly making a meal of his erstwhile adversary. These habits are peculiar to animals leading a solitary life and subject to sudden fits of passion as in the feline tribe.

The slender loris has a curious drinking habit : exercising the utmost circumspection, he approaches the dish containing milk, and standing on three limbs, dips the fourth into the milk as suddenly as he withdraws it and licks the moistened hand leisurely. He repeats this a dozen times or more, soon after the milk is poured into the vessel in the evening, using the right or the left front limb indiscriminately but never the two together. When a powerful male is engaged with the dish, the others in the cage keep at a distance, moving about and setting up a plaintive cry not unlike that of a half-dreamy crow suffering from a nightmare. The younger and the female members may be seen drinking together in this odd fashion from off the same dish with few quarrels. I know of no mammal which uses the front limb as a spoon and no primate like the lemur which does not use it in eating,—the loris applying the mouth straight to the food in a quadrupedal fashion. Like all the rest of the mammals, the loris drinks profusely before proceeding to feed.

The Loris is a packed essence of pugnacity. When freshly captured and put into a cage, he objects to your presence by hissing and spitting in a wild-cat fashion, and if the hand is incautiously put in a wrong place, he will bite with great malice. When thoroughly roused, he will inflict a series of bites, chewing the flesh and holding firmly the opposing finger, until you squeeze the neck to release the grip. The wounds have to be touched with iodine immediately, else they heal with difficulty and sometimes suppuration may result. When trying to terrify you, he makes short leaps forwards rubbing his snout against the wire-netting and raising the whole body the while ; but when thoroughly frightened, he will utter a piercing volume of yells like a wounded dog. These little creatures have a variety of ' voices ' expressing their different emotions. After a comfortable feed on bananas, cooked rice and milk, they will be moving about for the pure love of exercise, uttering little cries of happiness very nearly expressed by the crows when they compare notes in the evenings or plan foraging expeditions early the next morning. When two males fight, they literally mew like cats and the sense of victory and defeat is expressed by a series of guttural sounds very similar to the chattering of monkeys. As I have stated already, fear or alarm is denoted by a low moan rising in a crescendo until it attains a fearful yell. Though the courtship of these animals is not an elaborate affair it is interesting owing to the fact that at the breeding time the males utter a series of short yelping cries as the little pups do when they rub their noses against your legs, —which noises are apparently musical to the ears of the female but perfectly ludicrous from the human standpoint. When happily perched in safe shelters, both males and females screech very like the little owls *Athene*, apparently going through a piece of unrehearsed musical composition, each member vying with the other in musical ability. It seems to me that these musical duets are in the nature of defying challenges, for they are abruptly brought to a close by two males locked in deadly grips.

Hunting for lice in which *Macacus* indulges his leisure so scarce in a life excellently adapted for larceny, is not a relaxation with the Loris. Like other solitary animals his coat is comparatively clean and in the evenings when he attends to his toilet, he is seen combing his fur with his pectinate lower incisors and moistening it with his tongue. He cleans his face, by no means pretty, with his hands and arms in a pecfectly cat-like fashion. When there is peace and understanding, I have noticed two adults of opposite sexes, softy combing each other's coats with their teeth,—a habit which we associate with the Dhobi's animal. Young lemurs are attended to by the mothers who keep them perfectly clean. I have found few lice and mites and ticks in their skin, but in captivity the bare portions of the limbs develop a kind of scab which is scratched persistently by the claw on the second digit of the leg till the surface bleeds. The limbs are sufficiently long to reach any part of the body for the purpose of scratching the irritating surface.

I have not succeeded in humanizing these little Ishmaelites into softer domestic ways; they retain their temper throughout confinement like the wild cats. But a friend of mine who has kept one or two of these lemurs as pets informs me that the animal can recognize its master and would come out to receive food at his hands without biting them. He asserts that beyond calling for food these little dreamy animals which look more metaphysical than poetic are incapable of expressing any other emotions towards man: and no psychology will avail in teaching them the simple lessons which are well within the scope of the ordinary simean cortex. The volume of education and the length of training are in direct proportion to the nature of life led by an animal, and in the present instance the wants of the loris being simple and easily satisfied, it has preferred to remain in comfortable dullness.

In South India these lemurs breed twice in the year. The sexual season falls in April–May and October–November. This is usually heralded by a wide-awake alertness on the part of both sexes in seeking out a mate. The period of pro-œstrum is marked by a sanguineous discharge through the genital orifice and the pendant clitoris and the margins below become swollen. On the conclusion of the pro-œstrum which lasts 7 to 10 days the male is received. But by far the most inexplicable part of the whole affair is that about this time, it is quite common to find two or three males stationed on the back or on the abdomen of a single female individual with perfect peace among them all. The female thus burdened may be seen moving about and the males are difficult to dislodge. When forcibly separated, however, instead of seeking another female, he runs after the old one who is already overburdened. In an animal whose life during the rest of the year is marked by mutual intolerance, a peaceful habit of this description is extraordinarily curious. The œstrum lasts for about a week and I must draw attention here to the fact that during coition the male holds the neck of the female by his teeth,—a feature which is prevalent among the cats. Apart from the low calls of both sexes which resemble the gentle cawing of early crows occasionally rising to chatterings by which the sexes are attracted to each other, they develop a peculiar odour, weak but unpleasant, which must have a recognition value. After this brief lucid interval, they revert to sleepy anœstrum. The period of pregnancy lasts from five to six weeks, and usually two young ones are born at a time, rarely one. At the time of birth, the female parent is covered with a yellow sweet smelling thin paste in the region of the mammary glands which are four and are now uncovered. The young ones crawl up clutching the hair of the mother and without any assistance on the part of the parent seek out and apply the mouth to the teat. In the earlier periods of growth the mouth is scarcely removed from the teats. It takes nearly a week or ten days for the baby to leave its station and try clutching the twigs. In captivity if the young ones are handled, the mother runs away instead of rescuing them or even resenting the action. It seems to me that the Slow Loris is a vast riddle.

C. R. NARAYAN RAO, M.A.,
Department of Zoology, Central College, Bangalore.

[Mr. Narayan Rao's remarks in reference to the female Slender Loris being devoid of maternal impulses corroborate Mr. Shortridge's statement that an angry female when irritated ' would even vent its rage on its own young which would chatter and bite back but never let go its hold ' (Mammal Survey Report, No. 9, *Journ.*, *B.N.H.S.*, vol. xxii, p. 286). In his note on the Malabar Slender Loris (*Journ.*, *B.N.H.S.*, vol. xxvi, p. 836) Mr. Kinnear mentions the incident of a newly born loris dropping off its mother one morning and 'after a few attempts to pick it up from a branch too high above, the mother gave up and retired with the remaining one to another corner of the cage.' As regards the food of the Slender Loris the same note records that a pair of Jerboas which occupied the same cage as a female loris in the Society's rooms, were killed and partly eaten by the latter. A Slender Loris kept alive in the Society's rooms fed readily on grasshoppers. Mr. Shortridge in his note mentions the same fact. He states that they are 'specially fond of grasshoppers, which they would hold in one hand and take bites from.' The pugnacity of these animals is confirmed by most writers who have had experience of them. Shortridge writes, 'They are extremely pugnacious and when several were kept together would fight and keep up a continual squealing throughout the day and night, while every day one or more would get killed probably more from exhaustion than anything else. Their method of fighting was very peculiar, it consisted of gripping each other by the fur of the head in order to keep the other's head away and then biting each other on the feet and hands drawing blood freely.'

Commenting on the noises made by the animal, Shortridge likens the sound made when fighting to the screech of the Spotted Owlet (*Athene brama*), he also traces a similarity in the appearance of the loris to the bird when in a tree especially among foliage, and remarks that the likeness is further manifested in their owl-like habit of swaying their heads from side to side. The only other sound ascribed to them by Shortridge is a faint chattery noise rather like that uttered by a monkey when irritated. Mr. Narayan Rao's description of the alarm note of the animal culminating in a 'fearful yell' appears a remarkable feat for so small an animal! EDS.]

II.—MAN-EATING TIGERS

I wonder if it is common for a tiger to make a solitary human kill and then renounce such food?

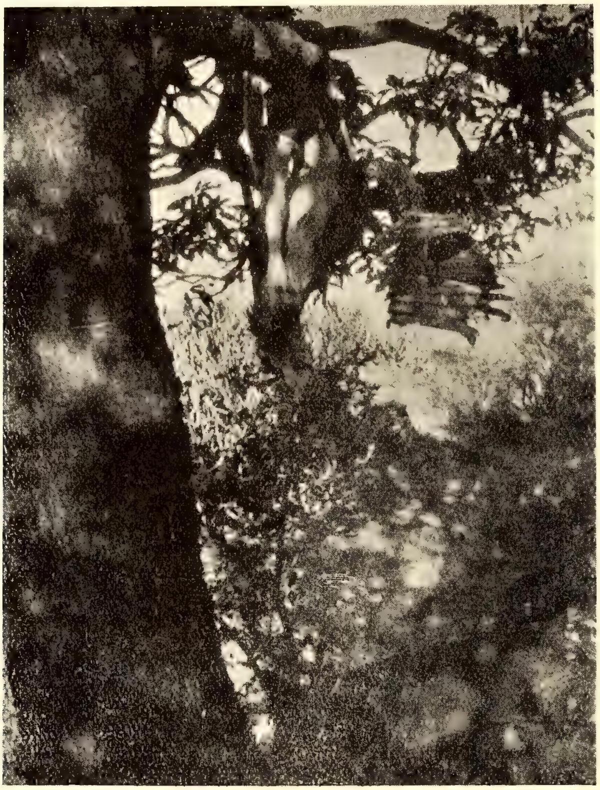
About two years ago a gang of coolies were regulating shade in a young tea clearing on these hills. At mid-day they went to their lines for food leaving one of their number behind. He presumably fell asleep. On their return all that was left of him was his cloth and bill-hook. They noticed tiger tracks and ran off to call the writer (the spot was about 10 yds. from a public road in full view and very much within hearing of a set of cooly lines). The writer some hours later pluckily (or foolishly) followed the tracks out of the tea and into some dense lantana where the top of the man's skull was found and further on the headless and limbless trunk. A friend then arrived upon the scene and as unfortunately neither of us was able to sit up, we, with the consent of the man's relatives, poisoned the corpse with strychnine (we could not allow such a danger to our labour to live) and carried it through a dark, gloomy ravine. It was nearly dark by now and following the tiger's tracks with our gruesome burden in that eerie light was jumpy work and when a monitor rushed off through the dry leaves my heart stood still! At last we left the corpse at a spot near water. Next morning an old, almost toothless panther was found dead and the tiger had also eaten and rolled about, but had vomitted and cleared off. He was seen the next day crossing a grass hill. Since then there have been no human kills (possibly his painfnl experience of the poison deterred him from further experiments?) and this was the first one on record in the last 50 years or so.

NELLIAMPATHY HILLS, A. P. KINLOCH, F.Z.S.
Janury 10, 1927.

III.—A PANTHER TREEING ITS KILL

(*With a photo*)

I enclose a photo of a panther's kill up a mango-tree, which might be interesting enough to publish in the Journal. The circumstances are as follows:—On December 26 I sat up over a panther's kill (a small cow), the panther came on at dusk and I got him dead with one shot (with a 280 Ross), he proved to be a good-sized male, 7 feet 1 inch. Next morning at 7 a.m. I came along the scene of the kill and disturbed another panther off the remains, I could not get a shot as only its head was visible for a second. That evening, 27th, a friend of mine sat over the remains in the same machan, a hollowed out cactus bush, but the panther did not appear up to 8 p.m., so he came back. I went there the next morning at about 6.30 a.m. and on approaching the place, saw the panther jump from a mango-tree overlooking the kill and on getting up to the tree I found the remains of the cow placed as shown in the photograph at a height of 8 feet from the ground ; as can be seen there was very little left of the cow, only its head, legs, skin and bare ribs and piece of the backbone, all devoid of meat except the head which was intact. There were claw marks up the trunk showing how the panther had sort of swarmed up it dragging the remains, which I estimated weighed about 20 lbs.



My friend sat up over the remains, which we pulled off the tree, but nothing came except two large mungoose and he returned to camp at 9 p.m. ; next morning there was nothing to be seen of the remains, they had all been carried off or eaten, a panther's tracks were plentiful all round, also those of two cubs, so the beast was evidently a she-panther ; it was curious the cubs had not been with her before.

AJMER,
January 14, 1927.

W. M. LOGAN-HOME,
Major,
4th Bombay Grenadiers.

[Several notes have appeared in the Journal on the well-known habit of panthers 'treeing' their kill. A photograph appears with a note on the subject by Mr. Coleridge Beadon on p. 744, vol. xix. Eds.]

IV.—WILD DOGS ATTACKING CATTLE

Recently a pack of Wild Dogs attacked a herd of my cattle here, devoured four calves and half-killed a cow. This is the first instance I have ever known of Wild Dogs attacking grazing cattle : though they have killed cattle that have been tied up as baits for tiger last year and this year.

These cases prove the increasing boldness of these dogs. Their increase in numbers, and diminishing numbers of deer, which they are exterminating, are causing them to harm cattle. On top of this the rewards previously given for their destruction have been withdrawn.

Attikan P. O.,
Mysore,
March 2, 1927.

RANDOLPH C. MORRIS.

[The reason for the withdrawal by the Madras Government of the rewards paid for the destruction of wild dogs was, we understand, a matter of retrenchment. Whether the saving effected by this means is sufficient to justify Government's action is a matter for speculation.

The Nilgiri Game Association have however found it possible to recommence the payment of rewards for the destruction of these vermin and the keeping down of Wild Dogs within due limits is more or less assured in the area under its control. Europeans resident in other areas subjected to the depredations of these pests will do well to destroy wild dogs irrespective of whether rewards are paid for them or not. The most effective way of dealing with the wild dog is by destroying the litters. The jungle man mostly knows where the whelps are dropped but he likes the Wild Dog, who often provides him with food, and is reluctant to aid in its destruction, still by paying liberally for whelps it is possible to get a good number brought in provided that the jungle man has not to travel too far to claim his reward and provided he is certain of receiving payment in full. Europeans residing in a district infested by Wild Dogs might band themselves together to secure prompt and easy payment for the destruction of litters. Eds.]

V.—JACKALS IN RESIDENTIAL COMPOUNDS

Reference a note by Mr. C. M. Inglis on jackals in a compound. Two jackals inhabit the extensive compound of the bungalow I reside in, presumably a male and female, and are very tame, appearing during most hours of the day. I frequently see the male chasing the female in the manner described by Mr. Inglis.

The hair on the male's neck is erect but his tail stands straight up and does not curve over his back. I imagine it is the preliminary stage of courting.

One afternoon I saw a pie-bitch slink out of a patch of high grass followed by the male jackal, who, with bristling hair and bared teeth, made short runs at the dog hissing like a tom-cat. The jack never actually closed with the dog. In a short time the female jack came out of the grass and trotted off in another direction whereon the male left the pie-dog and followed her.

Daltonganj,
Palaman District,
December 15, 1926.

RODNEY FOSTER,
Major.
No. 1 Party, Survey of India.

VI.—THE MATERNAL INSTINCT IN THE DWARF PIPISTRELLE, (*P. MIMUS MIMUS*)

Owing to the almost purely nocturnal habits and swift movements of bats, as an order, it is not often that the opportunity is presented to us and we are enabled to gain an insight into the more intimate life of any one of the species that we so often see flying around us in the dusk.

Such opportunities occasionally do occur, however, and as so little beyond the general outline is known of the habits of most of our Indian species, it seems worth while putting on record any new facts concerning their lesser known ways that may come to light; especially so when as in the present case, we meet with a phenomenon that we do not altogether understand,—I refer to the sense or 'instinct' that enabled the mother bat to discover her lost offspring.

One morning last month on returning to the bungalow after a morning spent on a Rubber estate, I was presented with a wee small bat—a very young Dwarf Pipistrelle, scarcely a quarter grown—alive but hardly yet able to crawl about freely. It had apparently fallen down from the roof outside the dining room windows from a colony of these bats, known to live in a hole beneath the eaves.

The young bat was placed in an ash tray on my writing table in the dining room to remain there until its fate should be decided upon and it could be disposed of.

In the evening, just as dusk fell and the lamps were lighted, forgetful of its presence, I sat writing at the table on which it lay, when I became aware of a bat fluttering round me and flitting about the rooms, an unusual, occurrence calling for remark. After watching this bat for a few moments it became evident that my desk was the centre of attention and it then dawned upon me that, possibly there was the mother come for her lost offspring—the young bat reposing in the ash tray.

Keeping quite still therefore I watched intently the movements of both, the young one being within 18 inches of where I sat, and a few minutes later, after a number of abortive attempts and much fluttering of wings, the mother bat—for so she must have been—dropped and alighted upon the ash tray beside her young one, which with her aid immediately scrambled round until it could cling to her and be suckled from her nipples.

After a few moments of this, and after having moved it about until it was comfortably settled and attached to her, with a laboured flap or two the mother rose into the air again, carrying her young one with her, and disappeared out of the open window after circling round and round the room for several minutes.

* * * * *

Curiously enough almost the same performance was repeated again a few weeks later with the difference that on this occasion there were several people present to witness it and the young one—a lively half-grown one this time—was put in a more easily accessible place. In this case, having returned late from Colombo, I noticed and remarked upon two bats flying round the room during dinner—to be told that a young bat had been found upon the floor and had been placed in a closed box to await my return.

Upon releasing the young bat which was well able to crawl but quite unable to fly, and placing it upon a book on a near-by table, one of the adult bats flew round and down towards it and after many attempts and much flying to and from eventually settled beside it and commenced to suckle it.

Seeing her engrossed thus, I switched on an electric torch and approached within a few feet, standing and watching while she suckled her young one which she continued to do for several minutes without taking the least notice of my close approach or of the strong light of the electric torch.

Eventually she too adjusted her young one and with it hanging to her breast launched herself off (with some difficulty, being much impeded by its weight) and disappeared out of the room into the night.

The foregoing would seem to indicate a degree of maternal affection unsuspected in this species of bat, the smallest in the Indian Empire. Not only has the mother bat sought out and discovered her straying offspring but she has ignored the close proximity of human beings and has continued to minister to its needs in spite of abnormal conditions.

I am however at a loss to understand how in both cases, the mother was able to discover the whereabouts of her young one. In the first case the young one was close beside me on my desk and I can vouch for it that it neither moved nor uttered any sound audible to human ears, until the mother alighted beside it and yet she appeared to know perfectly well where it was to be found although it had been on the desk since the morning and had been carried 10 or 15 feet from where it had been first discovered on the floor.

In the second case the whereabouts of the young bat were discovered by its mother while it was actually still shut up in a box, for when first seen she was circling over the table on which the box stood, and the table was some distance from where the young bat was picked up in the first instance.

In both these cases the mother would appear to have been guided to its offspring by some sense of which we are ignorant or else, alternatively, by a wonderfully developed sense of smell or hearing.

MATUGAMA CEYLON, W. W. A. PHILLIPS, F.Z.S., M.B.O.U.
January 20, 1927.

[The sense of hearing is very acute in bats and they are believed to be able to 'take in' sounds not ordinarily perceptible to the human ear. In no mammals are the ears so developed or so variable in form as in bats; in most of the smaller insectivorous species they are longer than the head and in one species the length equals that of the whole head and body. In several families of insectivorous bats a process called the tragus, or inner ear, rises inside the anterior margin of the ear. The tragus in some species is so large that if extends nearly to the outer margin of the conch. The function of the tragus appears to be to intensify and prolong the waves of sound by producing undulations in them. EDS.]

VII.—NOTE ON THE DESERT GERBILLE (*CHELIONES HURRIANÆ*)

These pretty little animals which are desert dwellers, as their name implies, are commonly to be met with in places where the sand has consolidated, living in colonies in burrows. These burrows are usually deep and made in bunds and dunes, both far from and near cultivation. A common haunt of these gerbilles is the flats where *Salvadora persica*, a small tree, grows.

It is a common sight to see them out at all parts of the day, sitting at the mouth of the holes and performing their toilet duties both in winter and in the height of the hot weather.

They possess a luxuriant growth of whiskers and these glisten and reflect the sunlight as they are moved about. This part of the animal arrests one's attention first.

If approached quietly they will permit one to come within a few feet, but on the slightest alarm will all disappear into their holes. Now if one sits quietly in a bush, soon one head and then another will peep out and then pop in again. As soon as they realize the danger has passed they will all come out and the whole colony will again be quite active on the surface.

A peculiar drumming noise is made with the hind feet a very quick *tu tu tu tu*, etc., when the animal is alarmed or curious. This point I observed with specimens in captivity. Six specimens of this interesting animal were forwarded alive to the Society by Mr. Laird-MacGregor from Gujerat. Three of them died but the survivors are doing very well. Their chief diet was Jowari and paddy until one day I gave them grasshoppers by way of a change and found that they were eaten with great relish. They drink water freely. They are very fond of gnawing and have in consequence almost eaten through their cage. The arched tiles under which they live are not spared.

The burrowing habit is inherent in these animals and even in the cage they are shifting the sand about from one place to another. Often I fill up the tile and watch them burrow. The sand is removed to the rear with the forelegs and is from there kicked away in turn by the hind legs in a galloping motion, when the mouth of the tile is open the animal goes in and continues kicking the sand out until it makes its appearance on the other side. It now turns round and goes out by the same hole through which it went in and removes the sand again from the mouth of the tile. I have not observed them to make any noise beyond a faint squeeking sound when held up by their tail.

When handled they very rarely if ever bite.

BOMBAY, C. McCANN.
April 12, 1927.

VIII.—HABITS OF THE PORCUPINE (*HYSTRIX LEUCURA*)

This Porcupine, like the Hedgehog, is commonly found tenanting the crevices in the lime stone conglomerate of the hilly area in Tatta, Karachi District, Sind. The main point of this note is to illustrate the fact that the Porcupine shares with the Rhino and some of the deer the habit of resorting to the same spot to deposit its excreta. The place is visited night after night by these animals resulting in a cone shaped accumulation of excreta which in one instance measured about a foot and a half high and a yard across. The animals are exceedingly shy of traps and avoided the spot when I set traps around it—as I was able to judge from the condition of the droppings when I visited the spot the next morning. I strewed pieces of potato over the heap to attract them and laid traps afresh but with no better results. The next night I removed the traps and placed a fresh stock of bait which was immediately consumed. I might say that the traps were in each instance buried and yet the animals easily detected their presence.

BOMBAY, C. McCANN.
April 11, 1927.

IX.—A WHITE ELEPHANT CALF

Reprinted from the 'Field' of December 16, 1926

Much interest has been aroused recently in this district by the birth of a supposed white elephant calf to one of the Borneo Company's timber elephants working teak in the Muang Fang Forest, north of Chiengmai. The calf was born on May 6th last and rumours at once spread among the native population that it had the attributes of a true white elephant, and this reaching the ears of the Chao Luang or Chief of Chiengmai and the Siamese Commissioner here, the calf and its mother, at their request, were brought down to Chiengmai, where the calf was pronounced to be a true 'Chang Peuak' or white elephant by local experts and entered the city in procession with the usual ceremonies. An official from the Royal White Elephant Department in Bangkok was also sent up to inspect the animal and report on it, and I am informed that his verdict supports that of the local elephant 'mors' or experts. The chief 'points' looked for, in such elephants, appear to be (1) a light red skin, the lighter the better, with still lighter coloured patches on belly and inside of legs ; (2) white hairs on body and tail ; (3) a very light pink palate or roof of mouth ; (4) eyes a light bluish-pinky colour ; (5) white toe nails. The number of toes does not seem to matter materially, but five on each foot, fore and hind, is considered, I believe, a mark of high caste. The calf with its mother, has been handed over by the Borneo Company to the Chao Luang of Chiengmai to look after, pending the visit of His Majesty the King of Siam to Chiengmai in January next when it will be inspected by him.

THE BORNEO COMPANY, LTD.,
N. SIAM. D. F. MACFIE.

X.—TWIN ELEPHANT CALVES

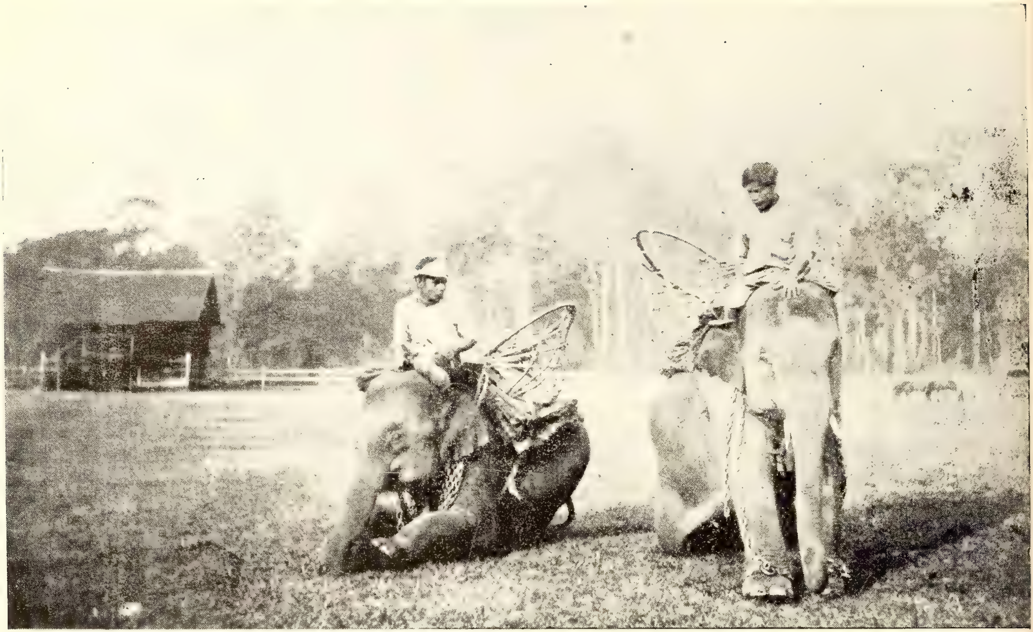
(*With a plate*)

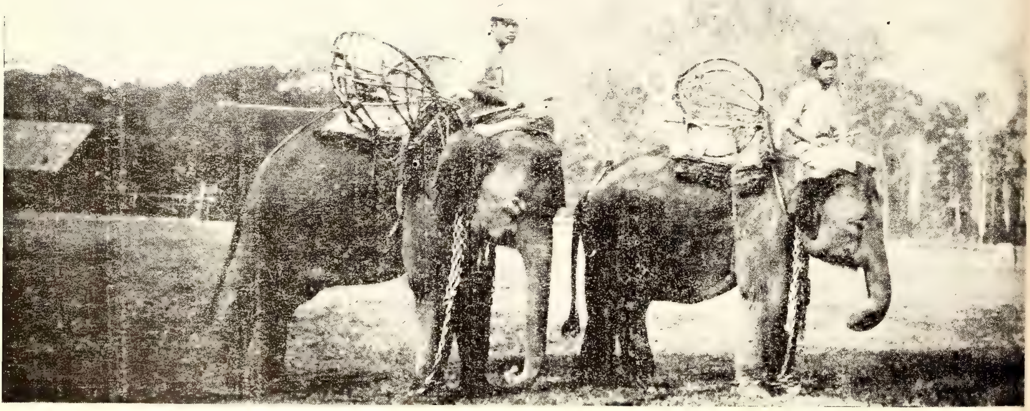
The following will correct inaccuracies contained in note No. viii, p. 813, of vol. xxxi, No. 3.

The twin elephant calves referred to by Major Stockley were born in June 1920, and 'other' calf in September 1921, so that the latter is some fifteen months younger than the twins and not older.

The 'other cow' elephant had produced four calves at the time Major Stockley saw her, not three only, and she has now another calf at heel born last month. This dam was about twenty-five years old when I saw her first and she may have produced other calves before this, of which I know nothing.

The twins at birth measured 2′ 10″ at the shoulder each whilst the other measured 3′ 1″.





THE TWIN ELEPHANT CALVES IN HARNESS.

(*Miscellaneous Note No. X.*)

All three are now ‘ in harness ’ and their measurements are as follow :—

Male twin, aged say 6½ years, height 5′ 9″, girth 9′ neck girth 5′ 5″.
Female twin 5′ 8″ 8′ 1″ 4′ 10″.
Other calf (female) 5′ 7″ 8′ 10″ 5′ 5″.

I had intended to send you a series of photographs of the twins but have been unable to put my hand upon all the necessary films. These contain also one film showing three generations.

C/o STEEL BROTHERS & CO., LTD., GORDON HUNDLEY.
RANGOON CAMP,
January 2, 1927.

[Since this note was written we have received a number of very interesting photos from Mr. Hundley of the twin calves, two of which are here reproduced. EDS.]

XI.—SOLITARY COW GAUR

With regard to Mr. Salim A. Ali's experience with a solitary cow gaur (*vide* note No. viii, vol. xxxi, No. 2), the only case of a solitary cow gaur I have ever come across occurred some years ago. I was asked by some Sholagas of these hills to shoot a solitary ‘ bull ’ bison which was giving trouble near their ‘ podus ’ in the tract of jungle (a Jaghir) they lived in. I had no difficulty in doing this—but found to my surprise that the solitary was a cow. It was very emaciated, and was evidently suffering from some disease. I learnt from the Sholagas that it had been in the same neighbourhood for three or four years but had only a short time previously commenced to be aggressive, probably due to increasing ill-health.

ATTIKAN P.O., MYSORE, RANDOLPH C. MORRIS.
January 1, 1927.

I was very interested by the note on the solitary cow gaur by Mr. Salim A. Ali in the last issue, as two years ago I was ‘ stung ’ in the same way. I had heard of a solitary bull near a village in the hills bordering the Nmai Kha, Upper Burma and went out after him. The first day I found large tracks of a solitary bison which I presumed was the bull, there being no tracks of any other bison in the jungle I had searched. I came up with the animal when its head was hidden by a clump of grass, but being a big beast and coal black I shot it. On examination I found it was very old and emaciated and I was astonished at the formation of its horns, which were the cow type but exceptionally large. On turning it over I was disgusted to find that it was a cow. I unfortunately did not measure the animal but it was as big as many shootable bulls I have seen. The measurements of the horns are :—Length of longest horn 27½″, girth 15″, span 28″, tip to tip across forehead 66¾″. The Kachins with me were equally astonished at finding a solitary cow like this. She was covered with scars, apparently from fighting, and I took two spherical lead bullets out of her, the wounds being quite healed up, also she had lost the end of her tail.

MYITKYINA, E. MAXWELL WEST,
November 25, 1926 *Captain.*

XII.—BISON AND CULTIVATION

Most shikar books emphasize the extreme aversion bison evince for the proximity of man.

There is an estate near here with a grass-jungle-topped hill rising about 400 feet behind the bungalow. From the hill people are of course clearly visible around the bungalow and every sound therefrom is clearly audible.

This hill is the favourite resort of what my friend the owner of the estate, calls his ‘ tame herd ’ and which he never molests. They constantly come out on that hill, usually in the early morning, and graze till about 9 a.m. As recently as this morning (I had been over for the night) we counted a sizeable young bull, 7 cows and 3 young calves. This is an increase of 4 in the last 2 or 3 years.

NELLIAMPATHIES, A. P. KINLOCH, F.Z.S.
January 10, 1927.

[There is a record in the Society's Journal of a pair of Gaur appearing on the rifle range at Kamptee, C. P., during musketry practice. One of the beasts made off in the direction of a neighbouring village while the other, after an eventful chase, was shot in Kamptee Bazar. Mr. Dunbar Brander who comments on the incident in 'Wild Animals in Central India' states that the animals were by all accounts trekking from the Chanda Forest to the Satpura Hills. He mentions two old bulls which he bagged with a right and left when leaving a village tank in Chanda. EDS.]

XIII.—WORN DOWN TIPS OF BISON HORNS

Dunbar Brander, among other writers, records that old bull bison (Gaur) use their horns as implements, with the result that their horns are worn down considerably. I cannot believe however that the wearing down of the tips of bison horns as one sees in old bulls, is entirely due to this and I think that it is due mostly to a failure of lamination after a certain age, and a close examination of heads with worn horns has strengthened my belief in this.

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE,
April 4, 1927.

RANDOLPH C. MORRIS.

XIV.—A FINE MUNTJAC

I send some photos of a fine muntjac shot by Major G. L. Lamotte, D.S.O., at Woodroffee Estate, Nilgiris, on April 16, 1910.

	Left horn.	Right horn.
Girth ½ way up	3¼″	3½″
Length of horn	6¾″	6⅝″
Pedicles	3½″	3½″
Girth above burr	4⅛″	4⅛″
Spread	6⅝″	

NELLIAMPATHY HILLS,
January 10, 1927.

A. P. KINLOCH, F.Z.S.

[Rowland Ward's 'Records of Big Game' give 7⅝″ as the length of horn of the best Indian Head. It was obtained in the Siwalik Hills, U.P.—Dunbar Brander mentions a head of 7″ secured by him in the C. P. The photos unfortunately are not suitable for reproduction. EDS.]

XV.—'CLICKING NOISE' MADE BY MUNTJAC

In Miscellaneous Note No. I, vol. xxxi, No. 1, Lieut.-Col. R. W. Burton asks whether I have heard the clicking noise (which I described in Miscellaneous Note III, vol. xxx, No. 3) made by muntjac when moving quietly away at a walk. I have, and I have found that chital seem to make this noise more than muntjac or sambhur. I have had several of these animals together tame, and the quiet clicking sound they made as they walked round inside their enclosure was very noticeable. The noise was undoubtedly made by their feet, and gave me the impression that their lower joints were stiff. This clicking, however, is not the noise I have previously described which is very much sharper and louder, and *only* made by the muntjac as it *bounds off*. Where muntjac are as numerous as they are in these parts this noise is heard with great frequency and I cannot understand how it is that Col. Burton has not heard it himself: unless it is a characteristic of the muntjac on these hills only, which is highly improbable.

ATTIKAN P.O., MYSORE,
December 18, 1926.

RANDOLPH C. MORRIS.

XVI.—PECULIAR CRIES EMITTED BY SAMBHUR STAGS FIGHTING

I recently watched a couple of sambhur stags fighting, and was struck by the extraordinary sounds they made. I was sitting on a hillside overlooking a Shola and first heard the cries in the Shola itself, and the noises somewhat resembled the whines of a pack of wild-dogs fighting over their kill, and I was preparing to descend to the Shola when out came two small stags and immediately commenced fighting in the open, and at the same time, emitting the cries described above. A better description perhaps would be the squealing of large puppies half playing and half fighting. The stags were not worth shooting, and I spent a most interesting hour watching a prolonged series of bouts accompanied by these strange sounds, which I have not heard sambhur emit before.

Attikan P.O., Mysore, RANDOLPH C. MORRIS.
April 1, 1927.

XVII.—MATING OF THE JUNGLE CROW (*CORVUS CORONOIDES INTERMEDIUS*)

Seeing an article in the Miscellaneous Notes by Mr. Salim A. Ali, on page 823, vol. xxxi of the Journal on the above subject, perhaps the following may be of interest to some of your readers.

Some few years back I happened to go out very early in the morning for a ride round Jakko. It was about March 15, the time being 5.45 a.m. As I approached the Ladies' Mile I put my horse into a sharp steady trot, and had not gone many yards, when I noticed a party of Jungle Crows (about seven in number) in the centre of the road. As I drew near the birds, the majority flew out of my way, leaving just a pair of them who were in the act of copulation, this being the first time I had witnessed these birds in this act. On the 19th of this month (March), I got up very early the time being 5.30 a.m. to take my morning walk. Whilst dressing I chanced to look out of the window and I noticed two pairs of Jungle Crows, within a few yards of each other both pairs engaged in the above-mentioned act. The birds were on a flat cement roof just opposite my rooms. Prior to the act the hen-bird shakes her wings, exactly in the same manner as the young of most birds are apt to do when being fed by their parents. I have now been in Simla many years and have always taken a very keen interest in the ways and habits of birds, so that it would appear that the mating of these birds in particular only takes place soon after daybreak, hence it is so rarely observed.

Simla, ARTHUR H. BERRIFF.
March 22, 1927.

XVIII.—THE BEARDED TIT, *PANURUS VIARMICUS RUSSICUS* (Brehm)—AN ADDITION TO THE INDIAN LIST

In the wide bend of the River Indus between the old moribund town of Attock in the Punjab and the mouth of the Kabul River there is a large island sandbank on which grows a dense thicket of sarpat grass and tamarisk scrub; this thicket is at least half a mile long and about 300 yards wide and its average height must be 12 to 15 feet, and it is so dense that to force a way through it is a matter of great exertion and difficulty. Bare sands surround the thicket and these are edged with stretches of large stones and pebbles where they border on the channels of the river.

On December 30, 1925, I visited the island expecting to find that it was the home of *Argya earlii* and *Laticilla burnesi*. I wandered about in it for some time and could find no signs of bird life save for an occasional faint squeaking note which was not identified though I attributed it as probably a note of *Prinia gracilis lepida*. However while proceeding along a rough trampled cattle path that ran down the centre I suddenly came upon a number of Reed Buntings (*Emberiza schœniclus pallidior*) that were feeding on the tall seed heads of the sarpat grass, and under them a flock of Bearded Tits. There were eight to a dozen of the latter and they were perching in the clumps of sarpat and peering at me and calling. They were quite tame and I had no difficulty in obtaining three specimens before the party moved away.

Time was limited and a hasty search did not show the presence of any more parties but the thicket was so dense that anything in it was easily warned of my progress.

The specimens procured were a male and two females. Their organs were quite undeveloped, they were not fat and there was no moult. All had been feeding on the tiny seeds of the sarpat grass.

I searched the island again on February 28, but could find no trace of Bearded Tits. Mr. A. E. Jones visited the island on January 16, 1927, with some friends, one of whom saw and described a bird that may have been a Bearded Tit. Mr. B. B. Osmaston on my suggestion has also searched the reed beds of the Kabul River near Peshawar without finding any trace of the species. At present therefore it is difficult to say whether the birds I saw were residents or stragglers from further north. It is usually regarded as a strictly sedentary species and it very easily escapes notice from the nature of its habitat so I still hope that ultimately it may be found to be a resident in the extreme north-west of India.

The specimens procured belong to the pale eastern race *Panurus viarmicus russicus* of which there is a good series in the British Museum from E. and W. Turkistan (Ferghana, Tianshan, Yarkand, Lobnor) and Mongolia; these are the nearest localities to Attock in which the species has been hitherto recorded and it is difficult to see how birds of this type could have crossed the Karakorum into the watershed of the Indus as mere stragglers. They are known to be resident in the swamps of Turkistan.

BATTLE, SUSSEX, HUGH WHISTLER.
February 11, 1927.

XIX.—OCCURRENCE OF THE PAMIR HORNED LARK (*OTOCORIS PENCILLATA ALBIGULA*) IN THE PUNJAB

On March 1, 1926, I was motoring into Rawalpindi from the direction of Attock when we disturbed a Horned Lark which was feeding on the road about 2.30 p.m. This was between Serai Kala and the Nicholson monument at Margala at an altitude of about 1,800–1,900′. It settled on barren ground at the side of the road and we stopped the car and went back to look for it. It was fairly tame and allowed me to get within 10 or 15 yards of it several times, merely rising and flying round with a strong rather swaying flight to settle again in the vicinity. The unbroken black gorget was very marked in life. I secured the bird and found it to be a fine male of the Pamir Horned Lark *Otocoris penicillata albigula* which is said to swarm in winter in Gilgit down to about 5,000′, but does not seem to have been procured south of that locality.

BATTLE, SUSSEX, HUGH WHISTLER.
November 2, 1927.

XX.—THE ROCK-SPARROW (*PETRONIA STULTA*) IN THE PUNJAB

When writing in vol. xxx of our Journal on the Finches of the Punjab I was unable to include the Rock-sparrow in my list as all the Indian records related to localities north and west of the Provincial boundary. It may now, however, be included in the Punjab list.

On December 30, 1925, I was staying at Attock and walked down to the edge of the Indus from the Public Works Department Rest House that overlooks the river. On the patch of rough sandy ground studded with Bir trees that lies at the foot of the Rest House knoll I disturbed a party of twelve to fifteen birds which flew down and settled amongst the reef-like rocks that line the shore of the river. They were rather shy and rose and settled again two or three times amongst the rocks before flying away to the hills behind the Rest House. Although I failed to secure a specimen I had a good view of the party with the glasses and was satisfied that they were Rock-Sparrows a species that I know well in Spain, Corsica, and the Pyrenees.

BATTLE, SUSSEX, HUGH WHISTLER.
November 2, 1927.

XXI.—THE MATING OF PAROQUETS

On the morning of February 27, at Cambay, I had the opportunity of observing for the first time a pair of the Rose-ringed Paroquet (*Psittacula torquata*) in copulation, and in view of the extraordinary antics indulged in by the birds—especially the cock—I think the following note will prove of interest.

I was staying in a somewhat crowded and antiquated part of the town, where the holes in the ancient walls provided excellent nesting sites for Mynas—Common, Bank and Brahminy—besides numerous Rose-ringed Paroquets. Close to my window was an electric wire post and on this the sundry occupants of the holes were to be seen at all hours of the day.

On the present occasion a pair of paroquets were sitting on the cable close to one another paying delicate attentions in the way of tickling each others heads and so on. In a little while the male sidled up closer to the female who responded by squatting herself flat, neck extended in front, flattening her back by slightly opening and raising her wings. The cock-bird now complacently climbed on to the hen's back with the help of his beak and there commenced a series of some extremely odd proceedings, difficult to describe. At first he kept to the left side of the females back only and commenced jerking his head up and down so that at each downward stroke of the head the culmen of his beak rubbed against the left side of the hen's head. After twenty jerks or so in this manner, he stepped over to the right half of the female's back and the jerking of the head was repeated, this time the culmen stroking the right side of her head. In the course of these proceedings the female frequently turned her head round and touched the cock's beak with hers.

This performance continued for fully five minutes. The cock now shifted himself to the centre of his spouse's back and with his wings open and drooping low on either side of her, tilted himself backward and the act was accomplished.

During the half hour I was watching the pair, copulation took place thrice, the birds moving off a little distance after each act, and sidling up again after a while. The last two 'transactions' occupied a much shorter time than the first.

It would appear that early morning is the time selected by the birds for this phase of their nesting operations, as though they kept to the neighbourhood throughout the day, no more of the business was noticed.

BOMBAY NATURAL HISTORY SOCIETY, SALIM A. ALI.
6, APOLLO STREET,
March 1, 1927.

XXII.—HABITS OF THE INDIAN SPUR-WINGED PLOVER (*HOPLOPTERUS VENTRALIS*)

1. *Protective devices.*—The Indian Spur-winged Plover haunts the sands in river beds. It has the plover-like habit of making forward rushes, then short halts during which it often stands on one leg.

It makes remarkable use of its protective colouring and behaves as if it understood the advantage of its dress. The following are the parts of its colouration which concern us. Its back is sandy brown, under parts white, crown black with a long crest throat with a black patch, wings largely black and white. The black and white of the wings would be very conspicuous were it not that when folded these colours are hidden by the inner coverts which are coloured light brown.

A bird clothed in this striking dress is certainly very obvious when in flight. It is equally conspicuous against a dark background or when standing on green grass. But the spur-wing keeps mainly to river beds, and so conducts itself in the face of danger that its colours blend remarkably with the sand. At the edge of the water it is conspicuous enough, for the sand is there wet and dark owing to the moisture sucked into it from the stream. And the spur-wing seems to know that the edge is dangerous, for, on my approach, it runs inward to the drier area where its light brown plumage blends with the paler sand.

Let us approach closer and watch how the bird behaves. It reaches the paler tract of sand, then halts, bends its legs, dips its head, depresses it crest, and lowers its body close to the ground. Its gait, if it moves, is very stealthy, and it is obviously trying to make itself look small. Sometimes it crouches very low and flattens its body down on the sand. Perhaps it may find a small hollow in which it can conceal itself completely from view. Thus the spur-wing seems to know that it must make itself inconspicuous, that its safety is secured by blending with the sand.

Other plovers adopt this ruse. The Little Ringed Plover, *Ægialitis dubia*, for instance, sometimes crouches in a similar way. It likes sandy places and is protectively coloured. Hence crouching conceals it in the same way as it does the spur-wing.

But the spur-wing shows other points of interest. If we try to make a circle round the crouching bird we will notice that it stubbornly refuses to face us. It will not show its breast. If it runs to another spot it may turn its tail to us, but its main object is to present to us a flank. As we circle round the bird turns also, with the result that we can get only a side view. If something forces it to turn the opposite way and make it present its head towards us, then it makes the movement sharply and rapidly, and we see it head-onwards only for an instant. Clearly the spur-wing will not face us, but compels us to look on its flank. The reason is that the bird is trying ~~to~~ conceal its most conspicuous part. Its black throat and white breast would be visible on the sand miles away. Its side view is a perfect blend. By the way in which it crouches and dips its head it manages to conceal its neck and throat partially, but it cannot hide them altogether. Hence the determination to show only a flank.

The Red-wattled Lapwing makes some attempt towards this same flanking ruse, like the spur-wing, its breast is the most conspicuous part. Its upper surface is dark brown which blends fairly well with the ploughed fields which this plover is accustomed to haunt. But if it is disturbed by someone approaching, it usually turns so as to present a flank. And if the observer makes a circle round it, the lapwing will repeatedly adjust its position so as to show only a flank.

Another point about the spur-wing's behaviour is this. While it is in the crouching attitude we notice that from time to time it gives its head a quick jerk. The act is momentary. Only for an instant is the head elevated, then it is immediately drawn down. This behaviour is linked with the protective attitude. For when the bird is crouching with head lowered so as to conceal the breast then its range of vision is much reduced. It must, however, watch the intruder. If it stands erect it makes itself conspicuous, and its main object is to avoid this. So it jerks up the head, takes a momentary glimpse at the intruder, then pulls the head down again. By so doing it makes the shortest possible exposure, and gets black to the protective attitude once more.

Thus we see that the spur-wing behaves as if it understood its protective disguise. The way it runs to the pale sand, the stealthy gait, the crouching attitude, the manner in which it persists in exposing a flank, the momentary glimpse that it takes with its head : all these are particular points of behaviour made to fit in with the colour scheme.

2. *Display.*—The spur-wing indulges in an interesting display which, had it occurred at another season, I would have associated with the sexual act. I observed it at the end of September. The swollen river had then shrunk leaving large patches of sand exposed. Spur-wings were accustomed to collect on these flats, sometimes in small flocks. Certain of these flats seemed specially attractive. One morning I saw a flock of spur-wings at one of these chosen spots. An unusual commotion was going on. Four of the birds stood apart from the rest. Three of them were making conspicuous display while the fourth seemed quite uninterested. They stood erect after the fashion of penguins, with heads thrust high in the air, breasts and white under parts ostentatiously exposed, especially the conspicuous transverse bands. In this peculiar attitude straight as a man upon his legs, they strutted about with an aspect of pride. Their affected gait was very amusing, the slow, measured, unnatural paces ; they looked as if showing themselves to best advantage at a kind of elaborate parade. Sometimes one would make a quick run ; the other two would immediately follow ; then the three would halt and start their strutting competition once more. At intervals they made bowing movements with their heads so as to hide momentarily the conspicuous breasts ; at other times they would spin themselves round in circles, making half a dozen or more turns. These evolutions were accompanied with clamour. The birds chattered continuously. It seemed as if a music competition was added to that of show. The fourth bird appeared to take no interest in the proceedings. It stood upon the sand a little distance away, balanced on one leg. Perhaps this uninterested spectator was the female ; but why should an ostentatious sexual display take place at this season of the year !

R. W. G. HINGSTON.

XXIII.—COMMENTS ON MR. J. K. STANFORD'S 'OCCURRENCE OF THE SHELDRAKE AND LAPWING IN UPPER BURMA'

Reference Mr. J. K. Stanford's note on the occurrence of the Lapwing in Upper Burma, published on page 823 of vol. xxxi, No. 3.

It may be of interest to you to know that Lapwing are quite numerous at Fort Hertz in Putao District, Upper Burma. In November 1923 I often saw as many as 20 in a flock on the grass fields bordering the Nam Palak and other neighbouring streams. They were very wary and I only managed to shoot one bird.

Capt. Fraser, who was at Fort Hertz, informs me that Lapwing were quite numerous during the cold weather of each year he was there. During the time I refer, to November 1923, I saw about half a dozen mallard, all drakes in full plumage, on the Nam Palak in company with a flock of Chinese Grey Duck. I shot three of the mallard and one Chinese Grey Duck.

The much lighter coloured throats of the latter were most conspicuous and the difference between the Burmese and Chinese variety of Grey Duck is very noticeable in this respect.

MANDALAY, UPPER BURMA,
December 31, 1926.

J. R. MUSGRAVE HANNA,
Captain,
Burma Military Police

XXIV.—OCCURRENCE OF SWINHOE'S SNIPE IN NORTH LAKHIMPUR

It may be of interest to the members of your Society to know that at a duck and snipe shoot got up by Capt. G. S. Lightfoot, Assam Rifles, at ' Demarjee ' in North-Lakhimpur (Assam) a Swinhoe's snipe was shot by that gentleman on November 28, 1926, and further that of the 62½ couple shot, with the exception of one Painted and this Swinhoe's, all were Fantails.

I see that in Mr. Stuart Baker's book, he records one shot in 1903.

NAGAGHOOLIE, T. E.,
OAKLANDS P. O., DIBRUGARH,
ASSAM,
December 6, 1926.

W. M. LEMARCHAND.

XXV.—THE BREEDING OF THE SPOTBILL DUCK (*ANAS PŒCILORHYNCHA*)

On November 8 last I found a Spotbill duck's nest with eleven fresh eggs in it, and to-day, some eighty miles north of the place, flushed another Spotbill which had nine ducklings with her, not three days old.

I have also heard of a third brood being found early in this month, near Udaipur. The time of year seems rather out of the ordinary, so I report these dates.

It has been an exceptionally wet monsoon in these parts, and the amount of water about is quite out of the ordinary. So is the number of duck on the tanks. Nor, in the past four cold weathers, have I ever come across unfledged young of the Spotbill in the shooting season, here in Udaipur or anywhere else.

CAMP UDAIPUR, MEWAR,
December 8, 1926.

C. G. CHEVENIX TRENCH.

[The Spotbill frequently has two broods a year. According to Hume, in Sind it regularly lays in April and May and again in September and October. In Gujerat and further south eggs are laid later. Whitehead saw tiny ducklings in November at Sehore (Central India), and it is possible that what Mr. Chevenix Trench supposes was the third brood may after all only be a belated second. Under exceptionally favourable seasonal conditions however, such as mentioned by the writer of the note, there appears no reason why a third brood may not be produced and it would be interesting to have conclusive evidence on the point. EDS.]

XXVI.—OCCURRENCE OF THE SHELDRAKE IN BEHAR

On January 20, while out shooting in the Monghyr District of Behar, about five miles from Damana Station, B.N.W.Ry., one of the party shot a Common Sheldrake (*Tadorna tadorna*) out of a batch of six flying over. I think the occurrence of this bird is sufficiently rare to cause the shooting of it to be recorded in your Journal.

PAKSEY,
February 6, 1927.

P. MURPHY.

XXVII.—FURTHER RECORD OF OCCURRENCE OF THE SHELDRAKE (*TADORNA TADORNA*) IN BEHAR

In vol. xxxi, No. 1, I see an article No. 9 on the occurrence of Sheldrake in Bihar.

While I was Manager of Japaha Factory in the Bhicaupur Concern, on two occasions I had the Common Sheldrake brought in to me by duck-netters from whom I purchased the birds and kept them with wings pinioned for quite a long time. They used to roam *ad lib* about the garden.

Also on the Attara Chainpur Chanar in the Kattra thana elakka my brother Mr. P. G. Munns and myself have seen flocks of over 20 birds and have killed quite half a dozen or so during our stay in Bihar.

I have never seen them on any other Chanar nor heard of any more being seen in this District. In this Chanar I have also seen large flocks of Comb Duck, Lapwing and Curlew, which are also not very common birds in this part of Bihar. The Attara Chainpur Chanar is now nearly dried up and most of the birds seen there are now found on the Burthua Chanar, some two miles distance.

SOOGONG, SEGOULIC P.O.,
CHAMPARAN,
December 28, 1926.

F. A. C. MUNNS.

XXVIII.—MIGRATION OF WILD FOWL

Since the publication of the record of recoveries of ducks winged in Dhar State (Central India) in February 1926 by the late Maharaja on page 1034 of vol. xxxi of the Society's Journal we have received the following communication from Prof. B. M. Shitkow of the Zoological Museum, Moscow, through the courtesy of Major R. Seymour Sewell of the Zoological Survey of India.

The letter refers to a second duck obtained in Asiatic Russia, regarding which we had asked for fuller particulars.

'In reply to your letter of December 9, 1926, I have the pleasure to inform you that the duck mentioned in our letters (No. 38—*Anas penelope*) was killed on August 1, 1926, near the River Kargat in the environs of the station Kargat (Railway Omsk,—Tomsk on the west of Nowonikolajewsk), approximately Lat. = 55½°, Long. = 80°. The duck was killed with young.'

This information is very interesting indeed. It is hardly permissible to draw conclusions at this stage, but the five records go to confirm the observations of other naturalists that the course taken by migrating birds is more or less directly north to south. In the case of our ducks the migration belt would appear to range between longitude 70° and 90°.

The distance between where the birds were ringed and where the last record comes from is approximately 2,300 miles in a straight line. Allowing for minor deviations on the route to circumvent natural obstacles such as deserts, high mountain ranges, etc., besides taking into account the fact that a great many birds go further down to the southernmost extremity of the Peninsula and into Ceylon, we would probably not be far out in conjecturing that many of our migrants must travel 3,000 miles or more each way. Additional interest is lent to this valuable record by the fact that the Pigeon killed was with young. Breeding marks the culmination of the outward journey and we would therefore consider this the most northerly point this particular bird was destined for.

Meagre as these records are, they show what important discoveries it is possible to make by employing the method of ringing wildfowl and we would appeal to all sportsmen in general, and to our sporting princes in particular to follow the lead given by the late Maharaja of Dhar.

We shall be happy to give any other information prospective experimenters may desire.

EDITORS.

XXIX.—LARGE FLOCKS OF THE COMB DUCK (*SARCIDIORNIS MELANONOTUS*)

Reference several notes on the size of flocks of Comb-duck, in 1925-27.

I came across large numbers of these duck in Bandelkund. On two occasions the numbers were very large. (1) On a tank with a village at one end and a small hill at the other when the first shot was fired large numbers rose, flew round the tank and passed overhead. I counted upto 50. There were numbers of Brown Coot on this tank but no other duck or teal. (2) On a shallow tank the deeper end of which was surrounded by the huts of a village, a number of Comb-duck and Ruddy Sheldrakes were found on the mud at the shallow end. On the first shot the Sheldrakes flew off : the Comb-duck circled round several times and then perched on the tops of high *mahwa* trees which were growing round the village. I counted 25 on the trees and others had flown off. These duck looked very awkward on their high perches and struck me as unnatural.

DALTONGANJ,
PALAMAN DISTRICT,
December 15, 1926.

RODNEY FOSTER,
Major,
No. 1 Party Survey of India.

XXX.—A CASE OF SNAKE-BITE DUE TO CANTOR'S VIPER (*LACHESIS CANTORIS*)

Reprinted from 'The Indian Medical Gazette,' vol. lxi (No. 3, March, 1926)

Many cases of snake-bite are annually treated in the hospital at Haddo, but as is usual the snake is never brought for identification and the majority of patients have failed to observe any particulars, or characteristics of the creature that has bitten them. An exception to this rule however occurred on July 30, 1925, when prisoner No. 32315 came to hospital after being bitten by a *Lachesis cantoris*, identified as such.

He had been bitten between the third and fourth fingers of the right hand at 3 p.m. on July 29. At nine o'clock that night he had severe vomiting which according to his statement was of a bitter greenish-coloured fluid. He had spent a sleepless night due to excruciating pain in the arm.

On arrival at the hospital (11.15 a.m. on July 30, 1925) the whole of the right arm was found to be very swollen, tense, and œdematous. Bullæ were found around the elbow joint, also posteriorly along the upper arm above, and the back and ulnar half of the forearm below. Temperature 98°, pulse 100, respiration 30 ; the patient was in great pain and was very restless. No abdominal pain was complained of nor was any tenderness elicited on palpation.

The pain extended up the arm from the fingers, then across the shoulder under the clavicle ; also the course of the bullæ appeared to follow the line of the ulnar nerve, going up into the brachial plexus.

5 p.m.—Temperature 98°, pulse 98, respiration 20. There was a general reduction in the pain, and a slight abatement in the swelling around the shoulder. Patient was still restless. Suffered from constant eructation, the abdomen was slightly distended, and flatus was being passed. The bowels had not moved, but he had urinated twice. There had been no vomiting since admission. I am not certain whether the abdominal discomfort (eructation and flatulence) was due to involvement of the splanchnic nerves.

July 31, 1925.—Morning temperature 98°, pulse 88, respiration 20. Patient did not sleep till after midnight because of the pain. This morning he has none, but is still restless. The treatment adopted so far has been free incisions, and arm baths in a warm 5 per cent. potassium permanganate solution, one intravenous injection of calcium chloride (1 in 20), drinks of hot milk, and 2 oz. of rum b.d. A purgative of calomel grs. 6, followed by magnesium sulphate 6 drs. was also administered.

July 31, 1925 (continued).—Evening temperature 98·4°, pulse 84, respiration 20. Bowels were moved thrice after the calomel, the stools being loose and yellow, there is no flatulence now. Restlessness has also gone. There has never been any epistaxis or sub-cutaneous hæmorrhages.

August 1, 1925.—Morning temperature normal, pulse 86, respiration 20. The only swelling to-day is in the forearm and fingers, and that too is rapidly going. From to-day only antiseptic compresses are being used. The anxious expression has also left the patient.

Evening temperature 101°, pulse 92, respiration 22, benign tertian malarial parasites found in the blood.

August 2, 1925.—From this date onwards there is nothing further of interest to record about the case. No slough came away from the forearm and hand where the incisions had been made. The patient was finally discharged from hospital on August 20, 1925.

The course of the pain from the fingers upwards seemed to have travelled along the course of the ulnar nerve and then the brachial plexus. I think it possible that the abdominal discomfort, flatulence, distension and eructation may have been due to involvement of the splanchnic nerves, but why so long after the bite I cannot understand.

From the notes on the case it will be seen that the respiration and pulse were both slightly accelerated. How much fright accounted for this cannot be said. That there should have been no sloughing is also a point to note. One other common snake in these Islands is the ***Lachesis purpureomaculatus*** (Gray's pit viper), and I am hoping before long to have the opportunity of recording the effects of the poison of this viper also.

Postscript.—Since writing this article I have been in correspondence with Colonel F. Wall, I.M.S., who is of the opinion that the three snakes *L. gramineus*, *L. purpureomaculatus* and *L. cantoris* can hardly be considered distinct species, and that the two latter are merely insular forms. A careful analysis of the lepidosis of the three shows only differences in the scale rows.

A. BAYLEY-DE CASTRO,
Junior Medical Officer, Haddo, Port Blair.

XXXI.—SNAKES OF SHOLAPUR

I give below a list of the snakes found in Sholapur during the years 1923-1926, as you would like to have a record of them in the Natural History Society.

2. The late Mr. R. E. Macpherson of the Laxmi Mill in Sholapur, who was a keen shikari and a naturalist had made a collection of some snakes in Sholapur in the years 1912 to 1914. He had sent these to the Bombay Natural History Society for identification. They were the following :—

Eryx conicus	2
Macropisthodon plumbicolor	10
Dipsadomorphous trigonatus	12
Lycodon aulicus	5
Simotes arnensis	2
Oligodon subgriseus	2
Tropidonotus piscator	1
Coluber helena	1
Naia tripudians	3
Bungarus cœruleus	1

3. I have been here as Civil Surgeon since 1923 and during the four years though no special attempts were made to catch or collect snakes, a good many were brought to me, since it was known that I was interested in them. The following species mentioned before were seen and found. They were :—

Macropisthodon plumbicolor	3
Dipsadomorphous trigonatus	5
Lycodon aulicus	9
Simotes arnensis	5
Tropidonotus piscator	1
Coluber helena	7
Naia tripudians	5
Bungarus cœruleus	1

4. Many of the *Lycodon aulicus* brought to me were killed or found in the compound of the Civil Hospital or that of the Civil Surgeon's Bungalow.

5. *Coluber helena* appears to be a very common snake, not only here, but also at Pandharpur. A few dozen live snakes were caught in 1925 at Pandharpur and sent to you to prepare casts for the Prince of Wales' Museum, Bombay. Nearly two-thirds of these were *Coluber helena*. Sholapur is about 1,800 ft. sea-level. (*Coluber helena* is usually found above 1,500 ft.)

6. In addition to the above, the following species not recorded by Mr. Macpherson were seen :—

Typhlops sp.?	4
Lycodon flavomaculatus	1
Zamenis mucosus	3
Lycodon striatus	1
Vipera russelli	4

7. *Lycodon flavomaculatus* and *Lycodon striatus* were identified at the Bombay Natural History Society and some others were sent there also to confirm their identification. The *Typhlops* were killed in my bungalow and in the hospital.

8. The Russell's Viper was not known as occurring here to the present European Officers in the station. One beautiful specimen with black *hollow* rings on the back, was brought to me killed in the fodder stacked for Municipal bullocks on May 26, 1926. On July 19, 1926, a baby Russell's Viper 10" long was seen and killed at about 8 p.m. in the verandah of the Officers' club where table-tennis is played. It was expected that the parent would be somewhere near. It was a curious coincidence that a big Russell's Viper (female) was killed in the open place in front of the District Judge's Bungalow near the club on October 3, 1926, and the District Judge, Mr. Broomfield, I.C.S., told me that an exactly similar snake was killed in his bungalow compound on October 10, 1926. This probably was the male. The bungalow has a cactus hedge round it.

9. Two other species should be added as occurring in Sholapur. These were found in January this year. In the big Sankrant Fair held here, there was a local snake charmer exhibiting snakes. He had 2 specimens of *Dryophis mycterizans* which were seen by me on January 19, 1927. He said he caught them in a field about 4 miles from here. The other is an *Echis carinata* (Phoorsa) which was seen and killed in the hospital verandah at 8 p.m., on January 25, 1927. It was very clearly marked specimen 16 inches long and looked fresh as if it had recently cast its skin.

SHOLAPUR, K. G. GHARPUREY, *I.M.S.*,
February 21, 1927. *Lt.-Col.*

[Lt.-Col. Gharpurey makes no mention of a saw-scaled viper (*Echis carinata*) obtained by his collector in the Sholapur District and brought down to Bombay. Our recollections of it are still very vivid as we took it out of the bag which it shared with other perfectly innocuous snakes! EDS.]

XXXII.—LARGE BROOD OF EGGS OF THE CHECKERED WATER SNAKE (*NERODIA PISCATOR*)

An example of the Checkered Water Snake (*Nerodia piscator*) was sent to us on March 22, by Lt.-Col. F. P. Mackie, I.M.S., of the Haffkine Institute, Bombay. The snake shortly after her capture laid 88 eggs. The eggs were not free but adhered to each other in a mass by means of a sticky fluid apparently secreted by the oviducts of the parent.

This is possibly the largest number of eggs in one brood recorded of this species. The eggs are soft shelled creamy white—not glossy—and the average measurement is $1\frac{1}{20}'' \times \frac{7}{20}''$.

BOMBAY NATURAL HISTORY SOCIETY, S. H. PRATER.
April 11, 1927.

XXXIII.—NOTES ON THE LIFE AND HABITS OF THE COMMON CARPENTER BEE (*XYLOCOPA AMETHYSTINA*)

The following notes were made on this small Carpenter Bee (20 mm. in length) in the Palni Hills (7,000–8,000′) of Southern India.

During the months November–January a few males, sex recognizable on account of yellow clypeus, were seen about in the broken and scattered rhododendron outside the pine plantations along the top of the steep southern escarpment. No females were seen and no nests looked for.

In February–March females were seen cutting out passages in the rhododendrons. Dry branches from 1 to 2 inches in thickness were selected.

The opening is as a rule on the lower or sheltered side of the branch and the burrow first made downwards. Edward Step, F.L.S., has stated that a second entrance or rather exit, is made at the lower end, but this is not the case with *Xylocopa amethystina* which has a much more curious arrangement to which I shall return.

The material was thrown out and allowed to blow away. When the nest tunnel was complete, material to close the bottom cell was taken from a new ' living room ' tunnel which was started upwards above the entrance. This upper tunnel was not kept at an even diameter like the nesting tunnel but often took a pear shape.

I opened a large number of nests in different states of construction and in every case found no sign of the upper ' living room ' tunnel until the first cell was constructed at the bottom of the nest tunnel. The greater the number of cells found complete so comparatively larger was the upper living room tunnel.

I conclude that the material from the living room tunnel was required for the partition placed above each cell but, of course, was unable to see the act. Cells numbered from six to ten the lower three or four first built, being noticeably larger than the top ones which ceased 1 to 3 cm. below the entrance. No signs of cells were ever seen above.

On March 8. I took two completed nests home for observation. Each had an elderly female sitting quiet in the entrance.

If a nest were watched for a few minutes and no traffic observed it was either complete or an abandoned old one. In the former case a light tap with a pencil would bring the owner to look out of the entrance hole. The black face of the female and her ragged edged wings and generally ' part worn ' appearance are sufficient to tell who she is and I imagine that my killing bottle did not anticipate nature by very long.

Of these two nests one top cell (the *last* completed) was opened sufficiently for me to see the inhabitant—a white larva—some 2 mm. long on a sticky yellow ball (pollen and honey ? sweet to taste but not agreeably so).

On April 4. Inspection showed a yellow colour and signs of wings and legs which were darkening on April 25.

On May 12 a male with wings undeveloped broke down the composition partition and emerged. My observation hole was made by removal of a replaceable bit of side of tunnel and had not touched the partition.

From 13 to 16 my victim walked about the stick in a slow and sickly manner, often returning to his cell and sitting looking out of the opening. The wings did not develop and he died on May 17 having refused to look at the various forms of food offered.

The inhabitant was large and on May 24 legs were black. This, a female, died immature in the cell on June 19.

I presume that in spite of my careful handling and attempts to maintain the natural angle at which the branch had stood, that movement had been too much for those that died. But the two that lived explained the absence of the lower exit door to nest tunnel. It is a case of ' the first shall be last and the last first ' and I shall be very pleased if any one can tell me how it is done. How exact must be the arrangement that allows these beasts to arrive at maturity in inverse order to that of their production as eggs, for if one arrived at maturity out of turn it would probably not be able to break down the obstruction caused by brothers whose order of precedence was attacked, even if the motive force would drive it to attack a second partition where one only is normal. Such an accident would raise an obstacle against the sisters whose turn was still to come and probably destroy the whole brood.

Further observation brought confirmation.

The nest is completed in about seven to ten days. Average number of cells eight. The imago appeared in strict inverse order to the egg The last laid egg and first imago were male and the first laid egg and last imago were female. Where sexes were not divided the extra one was generally a female. When the extra one was a male there were over the average number of cells in the nest. The appearance of the imagos from a nest completed in ten days was spread over some six weeks or more.

Xylocopa amethystina is a friendly bee easy to watch and very interesting. The larger size and black face of the female and the yellow clypeus on the face of the male making the sexes easily distinguishable. Fabre, on wasps, remarks on the larger cell and food supply and longer grub life required to produce the female, more—robust to perform her harder work than the male—whose business it is to be there ready to function when she appears.

But how is it done ? It cannot be a matter of larger cell and more food only

During June and July I examined a number of nests, best found at this time by lightly tapping likely looking branches, an answering buzz giving every

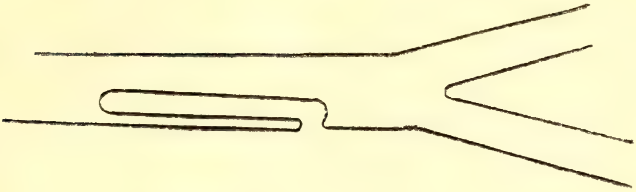


Diagram A.

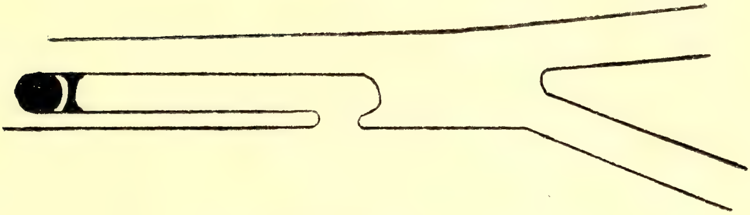


Diagram B.

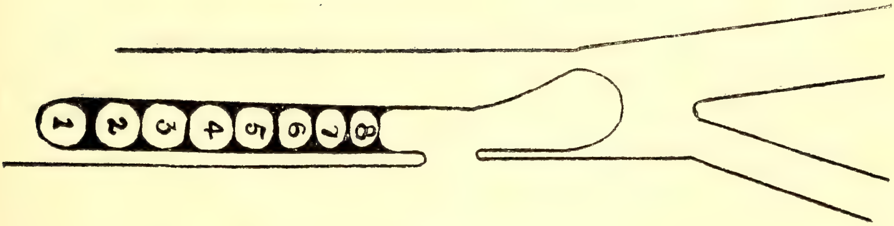


Diagram C.

Diagram A.

Nest under construction, a cylindrical tunnel downwards with the grain. Rounded at bottom (i.e., working surface). Entrance on lower surface of branch.

Diagram B.

First cell completed with ball of food and first partition made of material taken from above entrance.

Diagram C.

Nest complete with 8 cells and ' living room ' from which material for partitions has been taken. The adult emerges in inverse order to the building Nos. 8, 7, 6, and perhaps 5 being male and Nos. 4, 3, 2 and 1, the last to emerge being female.

Nothing happened for a week, so I opened all cells and all inhabitants were dead but one in the bottom cell (note :—the FIRST cell completed).

thing away. Tie a leaf over the entrance or stick a rolled one in the hole and you have the members of the family who are at home, at your pleasure.

The following points were noted.—

As each cell is opened the debris is cleared out. I never saw this being done but I never found any debris in the tunnel. The partition is so completely removed that one can feel no signs of it but it leaves a dark mark on the wall of the tunnel so that one can count how many cells a nest has contained. The family does not desert the nest on emergence from the cell. One sees members coming and going. I have taken four to six individuals of both sexes at the same time in the same nest using the lower nesting tunnel and upper living tunnel as a communal residence, sometimes with immature individuals always females in the yet unopened lower cells. Their fresh and brisk appearance is very different to the elderly female builder of the nest. They were seen to visit flowers in the neighbourhood and I presume that the community sheltered in their snug nest through the rains and cold weather until the opening of the season again in the following February. I saw no act of mating throughout the year.

CANNANORE,
December 13, 1926.

A. G. FRERE,
Major, F.Z.S.

XXXIV.—NOTES ON A COLLECTION OF BUTTERFLIES MADE IN JODHPUR AND MOUNT ABU DURING THE YEARS 1924, 1925 AND 1926

PAPILIONIDÆ

Byasa hector. Several specimens seen and a couple taken in Jodhpur during the rains of 1924. None seen subsequently in Jodhpur or at all in Mount Abu.

Byasa aristolochiæ. Exeedingly common in Jodhpur almost throughout the entire year. Rather rare in Mount Abu.

Papilio polytes romulus. Fairly common in Jodhpur and rather rare in Mount Abu. Have taken the *aristolochiæ* as well as *hector* form of female in both Jodhpur and Mount Abu.

Papilio demoleus. Very common in Jodhpur and fairly so in Mount Abu.

Pathysa nomius. I obtained a very poor specimen taken by one of the Lawrence School boys at Mount Abu in 1925. Am informed that in some years it is fairly common in the spring. Have never seen any myself however either in Mount Abu or Jodhpur.

Zetides agammemnon. Rare but a few specimens can usually be taken in October at Mount Abu. Not seen in Jodhpur.

PIERIDÆ

Delias eucharis. Have only seen and taken one specimen in two years in Jodhpur—uncommon also at Mount Abu.

Anaphæis mesentina. Very common in Mount Abu and Jodhpur. Some of the wsf specimens in Abu are very richly coloured both above and below.

Huphina nerissa. Very common in Mount Abu, less so in Jodhpur.

Appias libythea. Not seen at all in Jodhpur and rare in Mount Abu, but a few specimens can usually be taken in the early spring and also after the rains. In nearly all the females taken (both wsf and dsf) the upper portion of the rear half of the abdomen was found markedly red.

Catopsilia crocale. Common both in Jodhpur and Mount Abu.

Catopsilia pomona. Very common in Mount Abu—rather uncommon in Jodhpur.

Catopsilia pomona. ♀ *V. catilla.* Have seen a few specimens in both Mount Abu and Jodhpur, but they are rare in both places.

Catopsilia pyranthe. Very common both in Jodhpur and Mount Abu.

Catopsilia florella. Very common in Mount Abu and less so in Jodhpur.

Terias libythea. Uncommon in Jodhpur and none taken or seen in Mount Abu.

Terias venata. Common in Mount Abu and Jodhpur.

Terias læta. Common in Mount Abu and Jodhpur. I took one specimen in Mount Abu in which the ground colour was completely white.

Terias hecabe. Common in both Jodhpur and Mount Abu.

Ixias marianne. Very common in Mount Abu. None seen in Jodhpur. The female varies considerably both in size and markings, the ground colour of some specimens being strongly suffused with yellow.

Ixias pyrene. Almost the commonest butterfly in Mount Abu. None seen in Jodhpur. The type appears to be a local one as the females are practically exclusively white (I have only seen one yellow one in several years collecting), while in the male the base of 3 upf is yellow only in the dry season forms. In the wsf specimens the dark discal band practically cuts across the base of 3 upf.

Colotis amata. Fairly common in Jodhpur—uncommon in Mount Abu.

Colotis protractus. Not seen in Mount Abu. Common during the late autumn and winter months in Jodhpur.

Colotis vestalis. do. do.

Colotis fausta. I have seen a few specimens in the late autumn in Jodhpur but never succeeded in taking any. Have only come across one specimen in Mount Abu.

Colotis etrida. Fairly common in Jodhpur and less so in Mount Abu.

Colotis danæ dulcis. Fairly common in Jodhpur—am told it is also occasionally taken in Mount Abu but have never come across any myself.

DANAIDÆ

Danais limniace. Very common in Mount Abu, and also found during the rains in Jodhpur.

Danais plexippus. Fairly common in Jodhpur. Rather uncommon in Mount Abu.

Danais chrysippus. Exceedingly common in Jodhpur—rather uncommon in Mount Abu.

Euplœa core. Fairly common as a rule in both Jodhpur and Mount Abu but I did not see a single specimen during 1925 in Jodhpur.

SATYRIDÆ

Mycalesis mineus polydecta. Uncommon in Mount Abu. None seen in Jodhpur.

Lethe rohria nilgiriensis. Very common during 1925 in Mount Abu. None seen in Jodhpur.

Ypthima asterope mahratta. Very common in Mount Abu—rather rare in Jodhpur.

Melanitis leda ismene. Fairly common in Jodhpur and Mount Abu.

NYMPHALIDÆ

Charaxes fabius. Rare in Mount Abu. None seen in Jodhpur.

Euthalia nais. do. do.

Pantoporia perius. Am told this species is quite common in some years during the spring in Mount Abu, but have never come across it myself either there or in Jodhpur.

Hypolimnas misippus. Fairly common in both Jodhpur and Mount Abu. The females of this species were exceedingly common in Jodhpur in the autumn of 1925 ovipositing all over the lawns of the Residency at a time when hardly any other butterflies (including *Danais chrysippus*) were flying.

Hypolimnas bolina. Very common in some years in Mount Abu, especially after the rains. In Jodhpur uncommon at all times. I have also noticed in the latter place that while the females are of the usual large type, nearly all the males are very small.

Precis hierta, orithyia and *lemonias.* These are all very common in both Jodhpur and Mount Abu, as is also *almana* in Jodhpur. I have come across very few of the latter however in Mount Abu.

Vanessa cardui. Exceedingly common in Mount Abu. Rather uncommon in Jodhpur.

Argynnis hyperbius hyperbius. None seen in Jodhpur and only one specimen (a female) taken during 1924 and 1925 in Mount Abu. This year, however, I have taken quite a large number of females and also a few males in the autumn in Mount Abu.

Atella phalanta. Very common in Mount Abu. Fairly so in Jodhpur.

LYCÆNIDÆ

Tarucus theophrastus. Common in Jodhpur but rather rare in Mount Abu.

Enchrysope cnejus. Common in both Jodhpur and Mount Abu.

Enchrysope contracts. do. do.

Chillades laius. Only one specimen taken but not recorded whether in Jodhpur or Mount Abu, probably Jodhpur.

Zizera trochilus putli. Common in Jodhpur—rather rare in Mount Abu.

Zizera maha maha. A few specimens taken in Udaipur but none seen either in Jodhpur or Mount Abu.

Zizera lysimon. Common in both Jodhpur and Mount Abu.

Zizera gaika. Common in Jodhpur, fairly so in Mount Abu.

Zizera otis decreta. Common in Mount Abu after the rains. None taken Jodhpur.

Syntarucus plinius. Common in both Jodhpur and Mount Abu.

Catachrysops strabo. Common in Jodhpur—apparently none taken in Mount Abu.

Lampides boeticus. Common in both Jodhpur and Mount Abu.

Nacaduba nora. Only taken in the spring in Jodhpur, none seen in Mount Abu.

Jamides bochus. Only 1 specimen taken in Jodhpur—none seen in Mount Abu.

Azanus ubaldus. Only taken in Jodhpur where common.

Azanus uranus. do. do.

Virachola isocrates. A very few specimens only taken during the spring of 1925 at Mount Abu—not seen since.

Rapala melampus. Very common in Mount Abu during the spring. I think I have also seen a specimen of this insect in Jodhpur but am not sure.

Spindasis ictis. Common during the autumn of 1925 in Mount Abu, none taken in Jodhpur or during 1926 in Mount Abu.

Spindasis vulcanus. do. do.

N.B.—A few other species of *Lycænidæ* were also taken but as I am uncertain of their identification I have not included them.

HESPERIDÆ

Badamia exclamationis. Common in Mount Abu.

Hasora alexis. Common in Mount Abu.

N.B.—I have seen either *Badamia exclamationis* or *Hasora alexis* also in Jodhpur but am not sure which species, probably the latter.

Suastus gremius. Common in Mount Abu. None taken in Jodhpur.

Baoris bada. do. do.

Baoris mathias. Common in Mount Abu, also in Jodhpur.

Baoris colaca. Apparently only one specimen taken in Mount Abu.

Arnetta vindhiana. Common in Mount Abu, not taken in Jodhpur.

Telicota dara. do. do.

Hesperida galba. Rare in Mount Abu. None seen in Jodhpur.

Sarangesa purendra. Very common in Mount Abu after the rains.

Sarangesa dasahara. do. do.

Caprona ransonnettii. Rare in Mount Abu, none seen in Jodhpur.

Coladenia dan. Only 1 specimen seen and taken in Mount Abu. None in Jodhpur.

Udaspes folus. Only 1 specimen seen and taken in Mount Abu. None in Jodhpur.

A. D. MACPHERSON, C.I.E.,
Lieut.-Colonel.

XXXV.—THE OCCURRENCE OF THE WOOD MASON BUTTERFLY (*PARANTIRRHŒA MARSHALLI*) IN COORG

On October 3, 1926, I caught a single perfect example of *Parantirrhœa marshalli* on the Periyambadi Ghat Road, Coorg. This is of interest, as hitherto this very rare butterfly has only been recorded from Trivandrum, Travancore some three hundred miles away.

Although in the neighbourhood for a fortnight longer, I saw no further examples.

BANGALORE, H. C. WINCHWORTH,
February 14, 1927. *Major, R.A.M.C.*

[The record is of great interest and seems to show that this peculiar species may be spreading, since it was not obtained in Coorg by the late Mr. F. Hannyngton, whose list of Coorg butterflies is published in volume xxiv. EDS.]

XXXVI.—THE NORTH-WEST LOCUST IN SIND

The present has been a season in which, for the first time for a number of years, there has been very serious damage to many crops in Lower Sind by the attack of the North-West Locust (*Acridium peregrinum*). The damage was particularly serious in two areas, that on the east of Sind where as the result of unusually good rain the irrigated crops chiefly bajri in the desert portion of the Thar and Parkar district were better than is usually the case,—and that in the neighbourhood of Karachi, where the locusts swarmed down during the month of November, in swarm after swarm, and did a very great deal of damage to almost all crops that were standing. Though these were perhaps the two areas where the damage was greatest, yet there was very serious injury to crops up to about the latitude of Sehwan in Central Sind. Beyond that point northward no swarms were noticed, as far as I can hear. The cotton crops in particular suffered considerably.

My object in writing this note is, however, to draw attention to the behaviour of the swarms in Central Sind (Sakrand) not on crops, but on the jungle trees. In this area it is well known that in the jungle there is usually practically no herbage: all the vegetation consists of trees and shrubs. The swarms of locusts which came over near the end of November were in the swarming coloration. The direction they were taking was not by any means constant. In the jungle, to my surprise, the plant on which the locusts settled most abundantly was the leafless *Khirir* (*Capparis aphylla*). Nearly all the extremely abundant bushes of this shrub and tree were covered with them, and the ground round them was covered with them to an extent that no other part of the area was covered. They were vigorously gnawning the outer layer of succulent material from the green stalks of this plant,—and as a result, a few days later, almost all the shoots of many of these shrubs turned yellow and died.

The second plant which they seemed sometimes to attack in great abundance was the *Khabhar* or *Jhar* (*Salvodora sp.*), perhaps the most common jungle tree in this area. The young shoots were often completely defoliated on some trees only,—and the trees which the locusts favoured were in many cases so covered as to be weighed down as if covered with fruit. Only the leaves on the young shoots were usually taken and the trees seemed to be selected by the insects, for many of them were almost free.

Curiously enough, two other very common trees in this jungle,—the babul (*Acacia arabica*) and the *kandi* (*Prosopis specigera*), both of which were valuable fodder trees and which I should have expected to be relished by the insects, seemed hardly attacked, only a very few locusts were noticed sitting upon them. The same was the case with the species of *Tamarix* (Lai) which forms the other important constituent of this jungle.

I should be glad to know any other observations on the jungle plants favoured by the North-Western Locust, at the same or at other stages of their life history.

CAMP, SAKRAND SIND, HAROLD H. MANN,
December 15, 1926. *Director of Agriculture.*

XXXVII.—ON THE VITALITY OF THE CENTIPEDE (*SCOLOPENDRA*, sp.)

The following notes made by Prof. J. P. Mullan of the Department of Zoology, St. Xavier's College, are interesting and convey some idea of the vitality the centipede is notorious for possessing.

'September 23, 1926. Placed a living Scolopendra (Specimen A) in a cage.

September 24. In the same cage was introduced another living Scolopendra (Specimen B) slightly smaller in size than Specimen A.

September 25. In the morning it was found that Specimen A had devoured everything of Specimen B except the head with poison claws and the posterior portion of the body. The last four segments—(there are in Scolopendra about twenty-one segments bearing legs—) were intact. Everything within six segments preceding this portion had been eaten up leaving only the exoskeleton of these six segments.

On tapping the cage or touching this mutilated creature it was found that the legs of the last four segments commenced moving. I suppose it could have walked had it not been for the presence of the dead six segments in front of the living portion.

It remained in this condition for two full days (September 25 and 26). On the morning of the 27th no sign of life was visible.'

BOMBAY NATURAL HISTORY SOCIETY, SALIM A. ALI.
6 APOLLO STREET,
April 6, 1927.

XXXVIII.—THE POISON OF CENTIPEDES—BEING A SPECIAL REFERENCE TO THE ANDAMAN SPECIES

(*Reprinted from the Indian Medical Journal, June 1921*)

As I have had some experience, on the pathological effect of the poison of the centipede, both on human beings and animals, a short description of the phenomena will, I hope, be of interest.

The poison apparatus is formed by a modification of the first segment to form a pair of jaws, at the base of which is situated the poison gland, which communicates with the tip of the clawlike process by means of a duct.

The poison is an acid opalescent liquid, which has an intensely corrosive local action.

According to Castellani and Chalmers (*Manual of Tropical Medicine*, 2nd edition) 'Small children have been known to die from the effect of a sting, adults as a rule recover in about 24 hours at most.' On the first point I am thoroughly convinced of the great possibility of the fact, but on the second point I entirely disagree.

One of my cases, who was in hospital for three months is, at the time of writing, still attending the out-patient department, with an ulcer, the result of a bite.

In India and Burma I have not known dire results to follow a bite, but the reverse is the case in the Andaman Isles, where I have seen specimens of centipedes varying from 7″ to 13″ in length and from $\frac{1}{4}$″ to $1\frac{1}{2}$″ in breadth and from a light yellow to a dark greenish blue in colour. These facts I conceive to be proof of a great metamorphosis which has taken place due to natural environments. It is of some interest to note, that Burma, which is said to have been in some long by-gone days, connected with the Andamans and of which there is said to be some geographical proof, has centipedes not nearly so deadly as those in these isles, while the scorpionidæ there, are deadly, if I may so use the word, and they certainly are where children are concerned—are quite harmless here. There too the majority of scorpions met with are large and dark green in colour, here they are small and almost white. I have not come across many above 2″.

There has been no single case in my hospital who did not develop intense lymphangitis with œdema and inflammation of the skin and subcutaneous tissue, and in most cases a localized necrotic process was started at the site of bite, while in other cases there was set up in addition to this a process not unlike the old time phagedenic ulceration.

I must confess that most of the cases received into my hospital were always several hours after the bite, but even then they invariably had some sort of 'first aid' treatment, such as an application of tr. iodine, or the rubbing in of crystals of pot. permang. after making a nick between the two punctures of the bite, so that there is no reason to believe that means for combating evil consequences were not adopted.

The man was bitten on the night of January 27, 1921, at 11 p.m., by 11.45 he was in the detention ward and had received treatment; but pain being very severe he was sent to me at 6 a.m. (January 28, 1921). On February 1, 1921, an enormous necrotic ulcer had developed. Apart from this, there was considerable lymphangitis, inflammation, and odema of the leg up to the middle of the thigh. Pain of a constant and gnawing character was now complained of and ordinary bromide and chloral draughts had little or no effect.

On February 3, 1921, a gangrenous sloughing process had started from the lower end of the wound to beyond and below the internal maleolus.

On the February 5, 1921, a good deal of the slough came away. At the time of writing this wound represents a healthy, clean, granulating surface, there was no pain or any constitutional disturbance.

It is said that the poison 'when injected into the veins of a rabbit causes an immediate paralysis with coagulation of the blood, while under the skin it forms a large abscess' (C. & C. *Manual of Tropical Medicine*, 2nd Edition). The effects of the poison, both local and general, are very pronounced and the development in symptoms can easily be followed stage by stage. Locally at first there is a simultaneous sensation of heat and tingling, which is rapidly superseded by intense pain, radiating up and down the limb. At the points of inoculation two red spots of blood appear, which, within 24 hours, enlarge and disclose a necrotic area. Lymphangitis, with odema, and inflammation extending as far down as the deep fascia, soon supervene and is a common symptom. At times inflammation of the lymphatic glands takes place, but I have not found the process leading to suppuration in any of my cases. The necrotic ulcer keeps enlarging till about the fourth day when it is circular or oblong in shape, exposing about 3″ of slough with a further undermining of the skin for about 1″ all round.

Occasionally, however, as in three of my cases, very extensive and rapid sloughing takes place. Once the slough is cast off or cut away, a healthy granulating surface appears, but the process of ultimate repair is slow. One of my cases was three months in hospital, is an out patient now for more than a month, but still has an ulcer about the size of an eight-anna piece. Another of the bad cases came into hospital on January 24,—at the time of writing this, March 1, 1921, he is still in hospital with an ulcer 2 in. in diameter, with undermined and unhealthy edges. This man had a rise of temperature for three days, the highest rise being 102·8° on January 25, 1921. In almost all the cases that have come under my personal observation, tissue destruction has been most rapid and extensive. A jailor who has been here for many years affirms this observation too, and instances one particular case of another European jailor who was bitten in the upper left arm and in 36 hours had a 4″ sloughing ulcer, with excruciating pain of the whole arm and a high temperature.

The sloughing of the skin, subcutaneous tissue, fascia, muscle sheaths, and in some cases muscle fibres, is of a very acute necrobiotic process, while all the symptoms concomitant with an acute toxic condition are at the same time present.

Another point that is rather interesting is that in those cases in whom the phagedenic process was extensive, the pain was not of that extremely excessive nature as in other cases, but the patients were at times found to be in a dull semi-stuporous condition as was the case photographed. Some of these cases were undoubtedly of an acute gangrenous nature, and here probably a euphrobic condition was present. The ordinary general symptoms are hurried pulse, and slightly hurried respiration, headache, anxiety and pyrexia.

Apart from the knowledge gained in the wards, I carried out a few experiments, by causing live centipedes to bite, or, by injecting the poison with a hypodermic syringe. A record of some of these may be of interest.

A.—Guinea pig, female—bitten on the right shoulder by a large greenish yellow centipede at 10 a.m. Great restlessness, and whining—latter due to pain presumably. Noon: Great swelling and œdema extending up right side of face; 12.10 had a fit; 12.35 died.

B.—Guinea pig, young male, intravenous injection of the poison in saline solution. Developed a comatose condition almost at once. Died in 7¼ minutes.

C.—A frog injected with a solution of the poison developed no bad effects that were apparent, but 24 hours later the web of all four feet were noticed to be black. When let out of his cage he croaked and hopped away quite unconcerned.

D.—Pup, 4½ months old, bitten on the upper lip. Rapid heart, followed by irregularity and slowing. Developed a stuporous condition. Intense cellulitis followed in 12 hours and in 2 days an ulcer developed which took more than 1½ months to be completely healed. The pup during this period was very ill. On one occasion she passed a few drops of blood in her urine.

E.—Duck, adult, bitten at 10 a.m. below left eye, was dead in ten minutes.

F.—Drake, old, bitten on left thigh. Developed paralysis of limb in about 10 minutes. Unable to stand and refuses all food. Looks ill, does not mind being handled. Lethargic. In the afternoon it shuffled away to a cool spot under a rose bush.

Next morning there was a nasty slough of the thigh. Antiseptic applied. Bird had to be fed.

Next morning a bit brighter, ate a little cocoanut pap, wound was thoroughly cleaned and all slough removed.

Recovery was uneventful, but up to date the bird limps.

Note.—Of course none of these phenomena are observed in the case of a bite from a young scolopendra, from whom I also failed to extract the poison.

As regards treatment, I have found nothing to be of any avail if the period between bite and active treatment is delayed beyond an hour. After that incisions, and antiseptic baths, or compresses will be found good, but before that the crystals of pot. permang. rubbed into the wound after making a small incision, is as effective as liq. ammonia, or a paste of liq. ammonia and pulv. ipecac.

Haddo, Port Blair.

A. BAYLEY-DE CASTRO,
Junior Medical Officer.

BOMBAY NATURAL HISTORY SOCIETY

Proceedings of the Annual General Meeting held on March 8, 1927

The annual general meeting of the members of the Bombay Natural History Society was held on Tuesday at 6.15 p.m. in the Reptile Room of the Natural History Section, Prince of Wales' Museum. The Hon'ble Mr. J. E. B. Hotson, I.C.S., C.I.E., in the chair. One hundred and five new members were elected since the last meeting.

The appointment of officers for the ensuing year was as follows :—President —H. E. the Right Hon. Lt.-Col. Sir Leslie Wilson, P.C., G.C.I.E., C.M.G., D.S.O. ; Vice-Presidents—H. H. the Maharao of Cutch, G.C.S.I., G.C.I.E., the Rev. E. Blatter, S.J., Ph.D., F.L.S. and the Hon. Mr. J. E. B. Hotson, C.S.I., I.C.S.

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The annual statement of accounts for the year ending December 31, 1926, were presented by Mr. J. B. Greaves.

Sir Reginald Spence, the Honorary Secretary, then introduced Mr. S. H. Prater, the Society's Curator on his return from his deputation to some of the larger museums of America and Europe.

Mr. Prater delivered a lecture on 'The Services of Museums to the Public' which was based mainly on the results of his studies and observations in Museums in America and Europe. The lecture was fully illustrated with an interesting series of lantern slides.

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& SALIM A. ALI.

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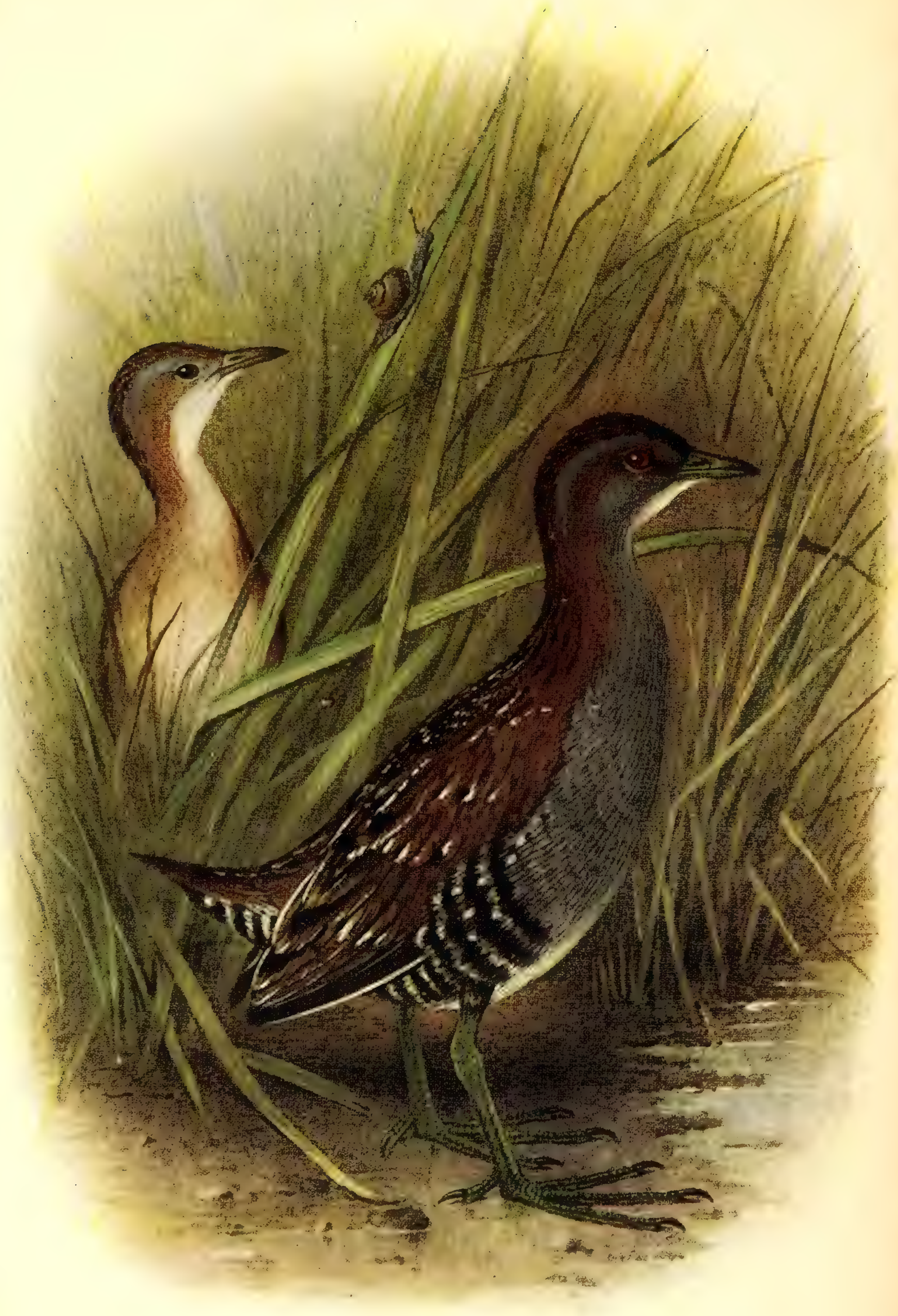

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THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

Vol. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

Part IV

(*With a coloured plate*)

(*Continued from page 13 of this Volume*)

Porzana porzana

The Spotted Crake

Rallus porzana, Linn., Syst. Nat., 12th ed., i, p. 262 (1766) (France).

Porzana maruetta, Blanf. and Oates, iv, p. 166.

Vernacular Names.—Gurguri-khairi (Beng.); *Venna-mudi-kodi.* (Tam.).

Description.—Centre of crown, nape and neck and whole upper plumage rufescent olive-brown, each feather from crown to tail with broad back central streaks; hind neck and upper back spotted with white; the lower back, rump, upper tail-coverts, scapulars and innermost secondaries streaked narrowly with white; outer wing-coverts immaculate except along the edge; inner wing-coverts with arrow-shaped white streaks edged with black; inner secondaries the same but with golden rufous margins to the inner webs; quills brown, the first primary edged with white; lores and round the eye blackish; a line behind the eye rufescent; supercilium, sides of the head and neck and whole breast grey, speckled with white and washed with brown across the breast; centre of chin and throat and abdomen white; flanks brownish-grey barred with white; vent and under tail-coverts buff; edge of wing white; remaining under wing-coverts and axillaries barred brown and white.

Colours of soft parts.—Iris reddish-brown to red; bill yellow, orange at the base and darker, more greenish at the tip and along the culmen; legs and feet bright olive-green.

Measurements.—Length about 200 to 220 mm.; wing 112 to 119 mm.; tail 47 to 52 mm.; tarsus about 33 to 35 mm.; culmen 19 to 21 mm.

Young birds are more brown below and have the white on the chin and throat more extensive.

Nestling.—Down all black.

Distribution.—Europe and West Central Asia. In Winter it migrates into Northern Africa and into India. It is not uncommon in Northern India from Sind to Bengal. Both Coltart and I found it in Assam and it has been recorded as far east as Arrakan. To the south it has occurred in Belgaum, and Jerdon stated that it occurred almost all over India but it is probably an exceptional visitor south of Bengal or to the east of Bombay in Southern India.

Nidification.—The Spotted Crake is only a migrant to India and it does not breed within our limits. In Central Europe it breeds principally during May and early June, but in Finland eggs may be taken as late as the middle of July. The nest is the usual rail-like affair of coarse grass and rushes lined with finer grass, placed in amongst vegetation around the edges of swamps, at other times in a dry patch in a marshy field and, less often, away from water in amongst long grass or standing crops. The eggs generally number 8–10 but frequently larger clutches are found, up to 15 having been recorded. The ground colour varies from greyish to greenish-buff and they are profusely marked all over with small spots and blotches of reddish-brown or purplish-brown with underlying spots of neutral tint and lavender grey. The eggs though quite galline in character can be separated at a glance from any of the other rails' either resident in India or migratory. The average of 100 eggs is given by Witherby as 33·62 × 24·57 mm., *maxima* 37·5 × 24·8 mm., 33·0 × 26·8 mm., *minima* 29·1 × 23·0 and 32·0 × 22·2 mm.

Habits.—Generally speaking there is little to record about the Spotted Crake which is different from that of its nearest allies. It arrives in North India in early October, the first few birds coming in some ten days earlier and they leave again in March or April. Like all the family it is a confirmed skulker and one but seldom sees it except when out Snipe shooting with a good line of beaters. It runs well, and in spite of the long distances it has to migrate, it is neither a very fast nor a very powerful flier. Like all the rails it swims well. Its food is both insects, small mollusca and worms as well as all sorts of seeds and shoots of aquatic inland plants.

PORZANA PARVA

The Little Crake

Rallus parvus, Scop. Ann. I. His. Nat., p. 108 (1769) (Karnthen).

Porzana parva, Blanf. and Oates, iv, p. 164.

Vernacular Names.—None recorded.

Description.—*Male*: Centre of crown and neck dark, slightly rufous-brown ; remainder of upper parts more olive-brown, darkest on the rump ; upper back, scapulars and innermost secondaries with broad black streaks and a few narrow white streaks, these latter also extending to the lower back, rump and upper tail-coverts ; wing-coverts light brown ; quills darker brown ; supercilia, sides of head and neck, chin and throat and whole lower plumage rather dark ashy-grey, the extreme posterior abdomen, flanks and under tail-coverts banded brown and white ; under wing-coverts and axillaries light slaty-brown.

Colours of soft parts.—Iris red, brown in young birds ; bill green, the base red in summer ; legs and feet yellowish-green to dull pale slaty-green.

Measurements.—Total length about 200 mm. ; wing 95 to 106 mm. ; tail 50 to 60 mm. ; tarsus 90 to 31 mm. ; culmen 18 to 20 mm.

Female.—Supercilia and face paler grey ; chin, throat and fore neck almost white becoming isabelline-buff on the rest of the lower parts, the vent and surrounding parts with under tail-coverts barred white and brown.

Very young birds have the supercilia, face and whole lower plumage white, barred with blackish-brown. These bars gradually disappear and in a more advanced stage the young become replicas of the female with very pale, almost white underparts.

Nestling.—All black.

Distribution.—Throughout South and Central Europe and South-Western and Central Asia migrating in winter to Northern Africa and to India into Sind and Baluchistan ; Scully also obtained it in Gilgit.

Nidification.—The Little Crake breeds throughout South and Central Europe as well as in Western Asia, probably as far East as Persia and Turkestan. The breeding season lasts from early May to the end of June though a few continue to breed as late as the middle of July. The nest differs in no way from that of the other rails, and like them is placed in any thick vegetation around lakes, swamps or the banks of streams. The eggs number from 6 to 12, generally 7 or 8. The ground colour is a pale ochre or buff brown, sometimes with a rather greenish tint, whilst the markings consist of numerous blotches and spots of darker brown scattered fairly numerously over the whole surface. There are also a few underlying spots of neutral tint and in some eggs these are rather more numerous and make the general tone of the egg more dull and grey. The surface is smooth and generally glossless. The average of 100 eggs is 30·45 × 21·73 mm., *maxima* 30·5 × 23·0 mm., *minima* 28·0 × 19·0 mm.

Habits.—The Little Crake must be a very rare visitor to any part of India, but it is such an inveterate little skulker that it is quite possible that it is not so rare as its very scanty records would make it out to be, so that sportsmen shooting on the borders of Baluchistan and the North-Western Frontier Provinces anywhere in the vicinity of water, should be on the look-out for it. Like all rails, it will not rise until almost trodden on and then gets up with a soft whirr of wings and flies rapidly away for two or three hundred yards when it drops suddenly into cover. In flight it rather reminds one of a quail but it has the usual little rail habits of keeping its legs hanging down until it gets well on the wing. Apparently this bird is almost entirely insectivorous in its diet and it appears to be especially fond of coleoptera and aquatic insects and in search of its diet it keeps almost exclusively to swamps and marshes, very seldom being found in dry grass or crops away from water.

PORZANA PUSILLA PUSILLA

The Eastern Baillon's Crake

Rallus pusillus, Pall., Reis. Russ. Reich., iii, p. 700 (1776) (Dauria).

Porzana pusilla, Blanf. and Oates, iii, p. 165.

Vernacular Names.—Jhilli (Nepal).

Description.—Upper plumage rufous-brown, the feathers streaked with black, the streaks on the hind neck inconspicuous and the wing-coverts without any ; scapulars, back, rump, upper tail-coverts and inner wing-coverts curiously streaked or marked with white as if smeared with white paint ; quills brown, the first primary conspicuously edged with white ; lores next the eye and a small streak behind it rufous brown ; supercilium, sides of head and neck, breast and anterior abdomen grey sometimes tinged ashy ; posterior abdomen, vent and under tail-coverts barred brown and white.

Colours of soft parts.—Iris red in adults, red-brown in younger birds and dull blue-brown in nestlings ; bill horny-green to green, the culmen and tip darker ; legs and feet yellowish-green to dull green, claws horny-brown.

Measurements.—Total length about 200 mm. or less ; being 84 to 91 mm. ; tail 40 to 46 mm. ; tarsus 27 to 28 mm. ; culmen 14 to 16 mm.

Young birds have the underparts almost white, the sides of the neck, breast and flanks suffused with pale ruddy-brown ; the brown eye streak is broader.

Nestling.—All black, a greenish tinge to the tips of the down.

Distribution.—Ceylon, all India, Burma and the Andamans ; as far West as Afghanistan and East to the Indo-Chinese countries and all China. It occurs through the Malayan Archipelago to the Philippines.

Nidification.—Baillon's Crake breeds in Kashmir in all the larger swamps and lakes, and Osmaston, Betham and others have taken many of their nests. Osmaston found it breeding almost entirely in and round the lakes and swamps, the nests, made of grass and weeds, lined with dry grass, being well hidden amongst thick cover either of reeds or of grass and weeds. In some cases the nest is built amongst reeds actually standing in the water, the bottom of the nest resting on debris or on some of the broken reeds. They are very difficult to find for the bird sneaks away as a rule before one has a chance of spotting her or, if seen, it is not until she has got some yards away from her home. The eggs number 5 to 8 and differ from those of the Little Crake in being much darker and more richly coloured and also in the surface of the shells being much more glossy. In the plains this Crake often breeds in rice fields as well as in swamps and lakes, whilst Butler took one nest built in a small clump of bullrushes in a bank three or four feet above the level of the water, a very unusual position for a crake's nest. The breeding season in Kashmir is from the end of April to the middle of June but many birds continue to lay up to the middle of August, though possibly some of these may be second nests. In the plains, like all other water birds, they do not set about their domestic affairs until after the rains break in June.

Habits.—Baillon's Crake is a common bird in suitable localities practically all over India and Ceylon but it is very seldom seen except when out snipe shooting or perhaps when after quail or on bits of dry cultivation between swamps. Its flight is exactly the same as that of the Spotted Crake already described, but its flights seldom last longer than 100 yards or so and once down it is extremely difficult ever to get a sight of it again. They are very fragile little birds and fall easily to very small shot at great distances but of course are quite unworthy of being shot and practically unfit to eat when they have been brought to bag. As a rule these birds are found singly, occasionally in pairs and, being resident in India, they do not congregate in small parties as most crakes do on their first arrival and prior to their departure from India. At the same time it is quite possible that a large percentage of our Indian birds do not breed in India or, if they do, they wander up from the plains into the swamps and lakes of the Himalayas for the purpose of nesting. Their diet is both vegetarian and insectivorous and they feed largely on tiny shoots and seeds of aquatic plants. One shot by myself had its stomach full of grasshoppers, these ranging in size from the smallest to others more than half an inch long. Mixed with these were a lot of tiny white roots, probably of a water plant, and one or two small land shells. Another bird seemed to have fed principally on very small black round seeds, but what these were I have no idea. They are very quick runners and moving amongst the grass from one place to another it is often very difficult to convince oneself as to which quarter their call is coming from. The call itself is distinctly crake-like, rather high pitched, it starts with a single loud ' Crake ' and then after a pause another and yet another in quick succession until the last few notes seem to run into one.

CREX CREX

The Corncrake or Land Rail.

Rallus crex, Linn., Syst. Nat., 10th ed., i, p. 153 (1758) (Sweden).

Crex pratensis, Blanf. & Oates, iv, p. 163.

Vernacular Names.—None recorded.

Description.—The feathers of the crown, hind neck, back and scapulars to tail with blackish centres and ashy margins, the two colours linked by chestnut brown; upper and under wing-coverts and axillaries chestnut; primaries, secondaries and primary coverts rufous-brown edged and tipped lighter; supercilium, lores, cheeks, chin, throat and breast ashy-grey, the chin and throat almost white and a darker brown line through the eye to the neck; flanks and sides of abdomen rufescent-white with rufous-brown cross bars; centre of abdomen almost white and unbarred.

In summer the supercilium, sides of the head, neck and breast are browner and less grey.

Colours of soft parts.—Iris hazel to red-brown; bill pale horny-brown, a little darker on the terminal portion of the culmen; legs and feet pale brown or fleshy-brown.

Measurements.—♂ wing 135 to 150 mm.; tail 40 to 50 mm.; tarsus 34 to 43 mm.; bill 20 to 23 mm.; ♀ wing 130 to 145 mm.; culmen 19 to 23 mm. (Witherby).

Young birds have the wing-coverts barred with white.

Nestling.—Black, the tips of the down in the upper parts dark buff.

Distribution.—Practically the whole of Europe and West and Central Asia. In winter it migrates to North Africa and a specimen was obtained by Scully at Gilgit.

Nidification.—The nidification of this bird is almost too well known to require description. It of course never breeds within our Indian area but it is still comparatively common in many parts of Great Britain. The eggs number anything from six to fourteen whilst clutches of eggs of eighteen have been recorded. The ground colour varies from a yellowish-or greenish-stone colour to light reddish whilst the spots consist of primary blotches of rather dark reddish-brown with others underlying them of neutral tint and grey.

Witherby gives the average of 100 eggs as 37·26 × 26·75 mm., *maxima* 41·6 × 25·9 and 38·3 × 29·0 mm., *minima* 34·0 × 25·0 and 34·3 × 24·1 mm.

The breeding season is principally during June but eggs are occasionally taken both in May and in July. The nests of the Land Rail are almost invariably placed in fields of grass and are often destroyed when these are cut for hay. Occasionally they will be found in nettle beds or masses of weeds alongside hedges, but such sites are exceptional.

Habits.—This rail is a migratory bird and the only really authentic instance of its occurrence within our limits is that of a specimen obtained by Scully in Gilgit. It is one of the most confirmed skulkers imaginable and even with dogs is extremely hard to put up, so that though one may hear its loud harsh crake sounding on all sides, one may hunt long and hard without successfully obtaining a sight of the birds uttering them. Its food is almost entirely insectivorous, but it occasionally eats seeds and will also eat any caterpillars, larvæ or earth-worms it may come across whilst hunting for food. Small grasshoppers form a very favourite article of diet.

HYPOTÆNIDIA STRIATA

The Blue-breasted Banded Rail

There are three well marked forms of this rail; the typical form from the Philippines and Borneo, a small dark bird with a moderate sized bill, which is *H. s. striata*; a large dark race with a large bill from the Andamans, *H. s. obscuriora* and, thirdly, a paler form first described by Horsfield from Java which is found all over India, Burma, Malay Peninsula to Java and East into South China and Formosa. The titles and first references to these birds are as follows:—

(1) HYPOTÆNIDIA STRIATA STRIATA

The Philippine Blue-breasted Banded Rail

Rallus striatus, Linn., Syst. Nat., 12th ed., i, p. 262. (Philippines).

(2) HYPOTÆNIDIA STRIATA OBSCURIORA

The Andaman Blue-breasted Banded Rail

Hypotænidia obscuriora, Hume, Str. Feath., ii, p. 302 (1874) (Andamans).

(3) HYPOTÆNIDIA STRIATA GULARIS

The Indian Blue-breasted Banded Rail

Rallus gularis.—Horsf., Trans., Lin. Soc., xiii, p. 196 (1821) (Java).

Vernacular Names.—Kana koli (Tam.); *Wadi-koli* (Tel.); *Yay-gyet* (Burm.).

Description.—Male: Crown to hind neck rufous; upper parts dark-brown marked with wavy white bars, broken into spots on the lower back and primaries, and each feather edged with olive-brown, much abraded in worn plumage; chin and throat white; sides of the head, foreneck and breast ashy-grey; abdomen flanks, under tail-coverts, axillaries and under tail-coverts dark brown barred with white.

Colours of soft parts.—Irides light brown in younger birds to Indian red in old adult breeding birds, upper and tip of lower mandible horny-brown to dark brown, lower mandible and commissure dull yellowish-red to bright red; legs and feet olive-grey, olive or fleshy-grey.

Measurements.—H. s. striata, wing 100 to 118 mm.; tail 38 to 41 mm.; tarsus 34 to 39 mm.; culmen 31 to 36 mm. *H. s. gularis*, wing 108 to 131 mm. *H. s. obscuriora*, wing 129 to 134 mm.

Females are a trifle duller, the chestnut of the head more inclined to be streaked with blackish and the abdomen paler, more whitish.

Young birds have the feathers of the back streaked with dark brown and the white bars and spots obsolete or absent; the crown and neck are rufous brown freely streaked with dark brown.

Distribution.—The Indian form is found practically throughout Ceylon, India and Burma in suitable localities where there are sufficient marshes and swamps and it extends, as already noted, to South China and Formosa. The Andaman form is restricted to the Andamans and Nicobars whilst the Philippine bird is also found in Borneo and the Celebes.

Nidification.—This Rail commences to breed as soon as the rains are fairly set in and the various swamps and jheels which it inhabits have begun to fill up. Over the greater part of India and Burma, August and September are the principal months during which eggs are laid, but I have found them as late as the end of October and also in the last week of June. The nest is generally a well-built one, a mass of weeds and rushes and, although that part of the material at the bottom of the nest may be decayed and wet, the upper layers seem to be always warm and dry. It may measure anything from five to seven inches in diameter whilst the depth varies according to the site. If built on dry ground, it will probably be only two or three inches deep but if on wet ground or in amongst rushes and plants in the water, I have seen them as much as a foot in depth. As a rule it is built either well in the swamps where there are plenty of weeds and vegetation or amongst the reeds, grass or bushes on the edge. Occasionally, however, it is built some distance from water but always amongst thick vegetation and well hidden. A pair of these birds built every year in a dry ditch running alongside the bungalow of the Police Officer at Jalpaiguri in Bengal, laying each year five or six eggs from which one or two chicks at the outside ever reached maturity. Unless the eggs are hard set the bird is not a close sitter but sneaks quietly off the nest whilst intruders are still at some distance. The number of eggs laid varies from five to eight, but six seems to be the normal full clutch. They are decidedly handsome eggs, the ground colour varies from almost pure white with just a faint tinge of cream or yellowish-stone to a warm salmon buff. The markings consist of reddish or purplish blotches and spots scattered rather sparsely over the whole surface of the egg but rather more numerous at the larger end though they seldom tend to form either a ring or cap. Some eggs have the markings feebler and paler consisting more of freckles and small longitudinal blotches of light red plentifully scattered all over the egg. In shape the eggs are generally rather broad ovals occasionally somewhat longer and rather pointed at the smaller end. The texture is strong, smooth and close and some few eggs have quite a fair gloss. Incubation is said to take from nineteen to twenty-two days but I have no personal experience about this.

The nesting of the Andaman form differs in no way from that of the common Indian bird. It is extremely plentiful in several of the islands and Mr. B. B. Osmaston during his stay in the Andamans took a wonderful series of their eggs. These are decidedly handsomer on an average than the eggs of its Indian cousin. Many eggs are a most beautiful salmon-pink in ground colour, others of light brick-red and others again are of pinkish-buff. The markings also are rather bolder and richer in tint, whilst eggs of the profusely but feebly marked type seem to be very exceptional. 200 eggs of the Indian bird average 33·7 × 25·8 mm.; *maxima 36·6* × 28·6 and 36·3 × *28·8* mm.; *minima 30·6* × 25·0 and 33·9 × *23·9* mm.; 150 of the Andamans eggs average 36·0 × 27·5 mm., *maxima* *39·2* × 28·7 mm., 37·0 × *29·4* mm., *minima* *32·7* × *25·0* mm.

Habits.—The Blue-breasted Banded Rail is one of the most familiar water birds over the whole of the Oriental region and there is hardly a village pond which does not contain a pair of these birds. In such places they become extremely tame and familiar and even on the larger swamps and lakes they seem to be aware that they are of no use as food and that consequently nobody cares to shoot or trap them. They are of course adepts at swimming and are quite capable of diving, but seem very seldom to resort to it. They are excellent walkers and may very often be seen, especially in the early mornings and evenings, wandering about the edges of swamps and even in the fields some distance therefrom. They progress with rather long deliberate steps, bobbing their heads and jerking their tails up as each foot advances. When undisturbed their carriage is very upright, their tail being held almost at right angles to the body, but if disturbed, they at once slink off, crouching low down amongst the grass or, if there is no cover, scuttle rapidly along for a few paces and then take to flight. Their flight is poor and laboured and they never seem to care to travel far at a time. They feed both on small water snails, insects, etc., as well as on seeds and shoots but I think their diet is mainly insectivorous. When searching for water insects or those which are found on floating vegetation, it moves about very nimbly upon the latter, constantly picking here and there as it goes. In the stomach of one bird I examined which was shot in Mymensingh on the banks of one of the big tidal rivers, I found a mass of tiny scarlet crabs, measuring barely ¼″ across the carapace. I have also found worms, beetles and grubs in their stomachs. The only notes I have heard uttered are a short jerking scream, not however very loud, and a deep low note probably uttered only by the male and quite inaudible to the human ear at a very short distance. They are pugnacious birds and I have often seen the males fighting during the breeding season, but the fights never seem to be long sustained and no damage ever appears to be the result. Their methods of courtship seem to be much the same as that of other rails. The male approaches the female with wings held low and vibrating constantly whilst the head, instead of being held upright as at ordinary times, is held comparatively near the ground and the tail very erect as usual. When within a few inches of the female, the cock draws itself up to its full height, spreads the wings still more and then crouches again, after which the performance ceases, perhaps to be gone through again in a few seconds.

They are resident birds wherever found though local movements may occur in times of excessive drought or of excessive rainfall.

(*To be continued*)

THE POTTER WASP

BY

MAJOR R. W. G. HINGSTON, I.M.S.

PART II

(Continued from p. 110 of this volume.)

EXPERIMENTS

I now pass to a series of experiments. They have been made with the usual purpose of investigating the psychology of the wasp.

I remind the reader of the architectural sequence as detailed in the last paper. It consists of four stages: First, a cell is built of clay; second, the cell is coated with gum; third, the cell is stuffed with caterpillars; fourth, the cell is closed with a lid.

Our experiments may be divided into two classes—(1) experiments relating to instinct, (2) experiments to prove intelligence. It is the old question. Is the wasp moved by instinct only, or can she view a problem intelligently; in other words, must her actions follow a strict routine, or can she alter her mode of behaviour in order to meet some particular need?

Let us see what the experiments disclose.

EXPERIMENTS RELATING TO INSTINCT

Experiment 1.—I find a nest of four cells. The fourth cell was finished two days ago. Since then no more work has been done. I cut away this last-built cell, excise it completely, and, of course, leave a deep gap in the nest. I watch to see what the potter will do. On the next day she discovers the damage, and sets about building her fifth cell in the place from where I had excised her fourth. So much for the first experiment. There is nothing very particular about it. It is a plain manifestation of instinct. For the wasp had recently finished a cell. Her next operation in the ordinary routine would be the commencement of the fifth in the series. Therefore when she builds in the gap that I had made, she is only doing in a different place what she would otherwise do elsewhere.

Experiment 2.—I wait till she has finished this fifth cell. When the lid has been secured I excise the chamber. That is, I open up the gap a second time. The wasp sets to work, and builds her sixth cell in the gap. I cut away the sixth cell, thus opening the gap for the third time. The wasp now does not seem so eager. She waits for seventeen days before rebuilding, then constructs her seventh cell so as to fill the empty gap. In all this we again see plain instinct. The wasp is following ordinary routine. But it shows us how persistent instinct is, and how stubbornly the architect sticks to her work.

Experiment 3.—Let us proceed. A wasp is building the cell wall. While the wall is undergoing construction I cut a strip of mud out of the edge. The deficiency is filled up without much trouble. When the wasp comes with her next pellet she just rolls in into the gap. This again is mere instinct, for when I remove the strip the wasp is engaged at building, the continuation of the act of building will of itself fill up the gap.

Experiment 4.—When the wasp is building her wall I cut a V-shaped piece from the middle of the edge. The damage is greater than in the previous experiment. The wasp, on returning, seems a little perturbed. She uses her pellet to fill the V. This we might expect. It is in accordance with the course of instinct. But the point of interest was that she did not thus employ the whole of her pellet. Her ordinary behaviour is to roll her pellet; that is her way of spreading it on the wall. In this experiment she puts part of her pellet in the V, and the remainder she rolls in the usual way. Thus the one pellet fulfils two purposes. One part repairs the gap; the other part increases the height of the wall. Again I see nothing in this but instinct, or at most just a trivial deviation from the course of ordinary routine.

Experiment 5.—A cell is built. It is being stuffed with caterpillars. While the wasp is away in search for a caterpillar I cut a wedge from one side of the gate. The wasp brings her caterpillar, stuffs it in, and returns again and again with more. But she never notices the broken gate. Yet the breach is large and the damage inconveniences her. For she now cannot fill her cell completely owing to the caterpillars falling out through the breach. Nevertheless she takes no notice, nor makes any attempt at repair. Nothing is done till provisioning is finished. Then she fills up the wedge-shaped deficiency when the time comes to close the lid.

Blind instinct, we may say, is the moving impulse. The wasp is provisioning, collecting caterpillars. This is not her time for masonry, hence she cannot repair the gate. Such might be the conclusion were our experiments to cease here.

Experiment 6.—Here is more convincing testimony. Not only does it show the blindness of instinct, but the futility to which it leads.

A cell is about half-built. The mason is busy at work. During her absence I fix to the edge of her wall a tiny pellet of mud. The nodule is no bigger than a pin's head, and I place it on the edge just at the point where the mason begins to roll her clay. The wasp returns. The strange excrescence strikes her immediately. She has been accustomed to an even edge. Here is something quite out of her experience; she has never met with anything like this before. What will she do? I expect to see her grip it and throw it to the ground. But this does not happen. She becomes agitated, first thoroughly examines the nodule, then withdraws into the cell and seems disinclined to build. Clearly she is very concerned at the unexpected state of affairs. But the nodule remains; she makes no effort to cut it away. Then she does something quite peculiar. She climbs out on one of her completed cells, tears from it a particle of gum which she smears on her half-constructed wall. Now this is very unusual behaviour. I have described how *Rhynchium* builds first her masonry, then applies the layer of gum. That is her ordinary sequence. Yet here, because of my nodule, she smears gum over a cell that is only half built. She fetches more gum, brings piece after piece, works with extraordinary energy, smearing as she never smeared before. This strange occupation keeps her busy till nightfall. By then the wall, though only half built, is thoroughly smeared and studded with gum. Her night is spent clinging to the nest. Next morning she takes up the task. The useless gum-smearing now ceases, and the work of building is resumed.

Now for the interpretation. The wasp will not ordinarily commence smearing until the cell is completely built. Yet here, because of my nodule, she begins to smear feverishly a cell that is only half-built. Is not this a fruitless mode of behaviour? What purpose can it have in view? I regard it as misguided instinct. Its meaning is as follows. The application of gum is a protective instinct, a device to keep parasites out of the cell. The wasp, when she finds the strange nodule, feels immediately on guard. To her it indicates intrusion. An enemy has been here. Her natural instinct of protection is aroused. This consists in collecting gum and spreading it on a cell. The instinct is most valuable, no doubt essential, when employed at the correct time. But here it is called forth by a strange experience introduced at an unexpected time. Hence the futility. The wasp is involved in many hours of utterly fruitless toil.

Experiment 7.—One last experiment, another display of blind instinctive force. A cell is almost built; only one or two more pellets are required. I place a fragment of camphor inside while the wasp is away collecting mud. Soon she returns. The unpleasant smell immediately distracts her. She tries to build, but the odour overpowers her, and she soon desists. She cannot work in this noxious fume. Her head goes down into the cell, with the pellet still in her jaws. The odour drives her back. She makes another effort, and soon her whole body disappears inside. But she has not the pluck to seize the camphor and cast it out of the cell. On the contrary I observe that same futile behaviour which took place in the previous experiment. She falls back on instinct, misguided instinct. Gum is torn from adjoining cells and smeared with persistent energy over the uncompleted wall. Till sunset this ineffectual toil continues; then she abandons the nest for the night.

Surely, as in the previous experiment, this spreading of gum is useless toil. It cannot remove the nauseous camphor, yet she sticks to it half the day. Such behaviour is misguided instinct *Rhynchium,* indeed, is little better than *Eumenes,* though *Eumenes* sealed camphor, egg and caterpillars all together in one cell.

These experiments explain my point. They indicate how strong is the instinctive force controlling the behaviour of the wasp. If experiment now ceased we might regard the wasp as a rigid mechanism compelled to work in an unchanging course. But such, I feel sure, would be a wrong conclusion. Further experiment will alter our opinion. It will show that something higher than instinct has a place in the insect's mind.

EXPERIMENTS TO PROVE INTELLIGENCE

Experiment 1.—A cell is built; the layer of gum is being applied. I remove the rim all round the gate, in fact amputate the upper fourth of the cell. Now I see a surprising result. I expect the mason to continue gumming; that was her business when I cut off the rim. But no. Without apparent disconcertion she gives up gumming, goes off, fetches mud, and rebuilds the edifice to the top. This is something quite unexpected. Certainly not in the course of instinct, but behaviour outside ordinary routine. Let us reserve the explanation. We must apply more rigid tests.

Experiment 2.—I have told how I excised a completed cell in order to see if it could be restored. But on one occasion I did additional damage. For clumsily I not only excised the chamber, but also happened to break the partition that separated it from an adjoining cell. A ragged breach was left through which the young wasp could be seen inside. What will *Rhynchium* do now? Certainly I did not anticipate her action. I imagined that she would follow routine, would ignore the damage, and set about building a new cell. Such is the accustomed action. When routine behaviour is interrupted an insect recommences at the point where the routine was broken. But not so in this experiment. The wasp is aware of the damage immediately, discovers the breach, tests it, gauges it, goes off for pellets of mud, and soon makes the rent secure. Not till this is finished does she commence building a new cell.

How can she be in strict bondage to instinct? Such behaviour shows a clear appreciation of conditions and a capacity to modify her actions in accordance as such conditions require.

Experiment 3.—I put her to a further test. A cell is built. The egg is inside. The wall has been smeared with gum. I make a hole in the bottom of the pot. It is about the size of her gateway, large enough for me to push in a forceps and extract the egg. What will her behaviour be now, in face of an experience altogether new? I expect to find her completely at fault. More than likely she will take no notice, just continue the instinctive round. Again I am mistaken. The wasp arrives, quickly finds the conspicuous rent. Perhaps she is aware of the stolen egg. At any rate a careful examination follows. Her antennæ investigate the edge of the hole; at intervals she bites at it as if testing it with her jaws. She stands astride the perforation, thrusts her head into it, then walks through it into the cell. But now see what happens. She pulls from the wall a bit of gum and smears it on to the edge of the rent. She digs out another nodule which she spreads in the same way. For an hour she continues trying in vain to close a hole by smearing gum around the edge. The operation was delightful to witness, the very hopelessness of it, the futility of employing gum to close a gaping rent.

The explanation is simple. When I broke into the cell the wasp had just finished smearing gum. This was the type of work on which she was last engaged. She finds my rent, endeavours to repair it, but, being under an instinctive impulse, strives to continue the same type of work. Hence she persists in gum-smearing and tries to mend the hole with gum. For two hours I watch her at this fruitless task. By evening nothing has been effected. The wasp spends the night in a perforated cell.

So far we see nothing but blind futile instinct. But wait. Instinct may have caused her much futile labour, but something better is about to take place. Next morning she takes an early flight. At her first return she examines the chamber and again carefully investigates the breach. She departs, and, at her second visit, brings with her a pellet of mud. Entering the cell, she commences repair. Clay is moulded round the edge of the breach. Working with infinite neatness, she first fills in all notches and irregularities, and thus converts my ragged opening into an evenly rounded hole. Then she extends more mud all round in the same manner as when closing a gate. The curved surface of the cell seems to cause her some difficulty. When closing the gate she places a flat lamina, but here she has to curve the clay. Nevertheless in the end she succeeds and accurately mends the hole. The work too is done with excellent finish; it is neat, smooth and gracefully moulded into the natural rotundity of the cell. Nor is she content with just a patch of mud. For when that is applied she goes off for gum which she smears all over the patch until it is indistinguishable from the rest of the cell.

Surely this act implies intelligence. It is a display of individual resource. Nor must it be imagined that the wasp was misled, that she confused the repair of a hole with the ordinary closing of a gate. For she did the repair in quite a different way. When closing the gate she sits on the outside and from there introduces the clay. When repairing the hole she first examined it from both surfaces, and then, having made a choice, elected to work from the inside. This, to my mind, is clear ingenuity. First she attempts repair with gum. This is mere instinct, the continuation of a psychic course. The act is futile; it fails utterly. A night's rest brings new realization. Now she breaks away from the bondage of routine, attacks the difficult problem intelligently, and repairs the damage with remarkable success.

Experiment 4.—Now for an experiment while the mason is building. A cell is under construction; the wall is three-quarters built. While the wasp is absent I make a hole in the wall. It is a ragged gaping rent, large enough for the wasp to crawl through into her cell. On her return she sees it immediately. Her actions show no sign of hesitation; she seems instantly to realize the right thing to do. In her jaws is a pellet, intended, of course, for building the wall. But the mason immediately diverts it from this purpose, carries it into the interior and applies it to the edge of the rent. Then she goes off for more material, at each visit moulds it round the edge until the hole is completely closed. Satisfied with this, she resumes and finishes building the wall.

Can we claim this as intelligent behaviour? Certainly the wasp was engaged at masonry when I broke into her cell. True enough she repairs the hole. But, after all, what is this? Is she not just continuing her work as a mason, though building in a different place? I grant it. Nevertheless I think there is something more. Some spark of intelligence must be given to the action. Unforseen circumstances have arisen, circumstances which are quite foreign to her life. She recognizes them, understands them, desists from the labour on which she is employed, and straightway puts things right. However I do not press the interpretation. Let us experiment still more.

Experiment 5.—From one cell of a cluster I excise the lid. This lid had been secured sixteen days ago, since when the wasp had not attended to the cell. *Rhynchium* soon finds out what I have done. Again she shows that swift appreciation which I have described in the last experiment. In five minutes she is off, returns soon to make a re-investigation, a desire, I take it to judge with greater accuracy the nature of the repair required. This second visit lasts only a moment. At the third she brings a pellet which she moulds round the edge of the gate. Others follow, and in a few more visits a new lid is built into the cell. Later in the day she gives it a finish, and smears it all over with gum.

Experiment 6.—Here is a more convincing result. Six weeks ago a *Rhynchium* had finished a cell. A young wasp had emerged from it, and the parent had replenished it a second time. For *Rhynchium,* we may remember, is attached to her nest, garnishing it, laying in it, replenishing it more than once throughout the year. For three weeks the wasp had been engaged at this replenishing, during which time she had done no masonry except for two small pellets which some days ago she had used for the lid.

I make a hole in the bottom of this cell. It is a small perforation, only the size of a pin's head. Later in the day the wasp discovers it, goes off to the trees, gathers some gum, and plugs my small hole. Gum is sufficient for this small aperture; three or four globules do the work. I now make a larger breach, one which she cannot repair with gum. Now see what happens. For days she has done no masonry. Her last act was to mend a small hole with gum. Yet she is not in the slightest disconcerted. Off she goes, collects clay, and builds a patch into the breach.

This, to my mind, is clear intelligence. There is nothing routine about behaviour of this kind. The wasp understands the problem before her; she appreciates the relation between cause and effect, and this stamps her as a rational being.

Let us sum up the result of these experiments. We are trying to demonstrate intelligent behaviour. What is intelligence? Without entering into technical definitions, surely an intelligent action is this. An insect is confronted with some new experience; it adopts an unusual behaviour in order to meet the requirements of that experience; then it must understand the nature of the experience; it must realize that a particular cause is capable of producing a particular effect, and that is the mind of an intelligent being.

Do our experiments demonstrate intelligence? Consider a few of them.

I made a hole in a cell three-quarters built. The wasp quickly repaired the damage. This, I think, requires some intelligence. The wasp must appreciate new conditions, must halt in the progress of her work in order to make the damage good. But I do not press the point. There is no change in actual routine. The wasp was plastering and the act of mending is a continuation of the plastering. If you like, it is only a diversion, only a kind of higher instinct. The mason is placing the mud on the rent instead of on the edge of the wall.

I made the hole when she was smearing gum. She began by behaving stupidly, trying in vain to close it with gum. This was a pure instinctive impulse. The wasp was just continuing the actions on which she had been engaged. Certainly she realized the damage, yet she stuck to her psychic course. In time however this stupidity ceased. She gave up smearing gum, went off for pellets, and built clay into the breach. In this we see intelligent behaviour, a clear recognition of changed conditions, a complete alteration in routine.

I made the hole in a cell that had been built six weeks ago. Here we have a crucial test. But the result is exactly the same. The wasp has not forgotten her old structure, for she soon builds up the hole.

Surely the meaning is this. A hole is made in the architect's wall. A strange experience is laid before the wasp, an experience she has never met with before. She recognizes it, deals with it, and repairs it in a rational way. Had she done so only when employed at masonry, then, I agree, it is instinct, or, at least, little more. The wasp would be only a living machine. But the facts are different. It matters not what the wasp is doing, whether plastering, smearing or provisioning, as soon as she finds a hole she repairs it in some suitable way. If it is large she mends it with masonry, if small she plugs it with gum. The point is that she repairs it on all occasions, sometimes slowly, sometimes injudiciously, but in the end does so efficiently and makes the damage good. In order to do this she alters her behaviour and breaks away from ordinary routine. There is only one conclusion. *Rhynchium* appreciates the meaning of new difficulties and takes rational steps to overcome them.

What is the mental force that underlies the architecture of the wasp? Unquestionably instinct, that wonderful knowledge, unlearnt, untaught, an innate inherited impulse handed down along the stream of time. But not this alone. I have tried to prove that there is something more, that there is the capacity to appreciate new experiences, the power to generate new thoughts, in fact the possession of intelligence and reason.

NOTES ON SOME SHORE FISHES FROM BOMBAY

BY

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The fishes included in this paper were all obtained off Bombay by Prof. F. Hallberg in 1925. They form part of the series of Indian fishes purchased from Prof. Hallberg for the collections of the Department of Ichthyology in the Academy of Natural Sciences of Philadelphia. A series of duplicate specimens has been reserved for the Bombay Natural History Society. The species are all of the littoral shore fauna of Western India, apparently representative of the more frequent forms, though several are of special interest none are new.

EULAMIIDÆ

Scoliodon acutus (Rüppell).

Two from open sea, 177 and 198 mm. Originally in formaline mauve to brown above, below light or paler.

TORPEDINIDÆ

Narke dipterygia (Schneider).

Disk subcircular, about wide as long; snout short, greater than interorbital, slightly convex across front profile as seen from above; eyes small, about half spiracle length, about 3½ in depressed interorbital; mouth small, protractile, width equals space to front profile; teeth broad low cusps in about 15 rows in each jaw, small size likely due to youth; internasal slightly less than mouth width. Spiracles continuous with eyes, greatly larger, ovate, edge entire. Skin smooth. Dorsal inserted behind tips of ventrals or little nearer origin of upper caudal lobe than ventral origin; tail little longer than rest of body.

Brown above, with several diffuse blackish cloudings medially. Dorsal and caudal brown, also upper surface of ventral. Under surface of body and ventral below white. Length 135 mm.

This species may be known by the deeply incised outer margin of the ventral so that the front rays form an anterior lobe. Also it differs further from *Narke japonica* (Schlegel), which has the raised rim to the spiracles.

CHIROCENTRIDÆ

Chirocentrus dorab (Forskål).

Depth 5 to 5¼; head 3¾ to 4, width 3¾ to 4. Snout 3½ to 3⅔ in head from snout tip; eye 4⅓ to 4½, 1⅛ to 1⅕ in snout, greater than interorbital; maxillary 1⅔ to 2 in head, reaches eye centre, slender; interorbital 5 to 5¼, scarcely elevated, level; cheek and preopercle with radiating venules. Gill rakers 7 + 18, finely lanceolate, more than twice gill filaments or 1¼ in eye. Scales minute most all fallen. Abdominal myomeres 24 + 13. Dorsal rays iii, 14 to iii, 16, first branched ray 2⅞ to 3⅒ in total head length; Anal rays iii, 26 to iii, 30, first branched ray 2½ to 2⅞; caudal 1⅛ to 1⅕; least depth of caudal peduncle 2⅞ to 3¼; pectoral 1⅗ to 2; ventral 3¾ to 4¾.

Brown, paler to light below. Neutral brown diffuse streak from above gill opening to middle of caudal base. Head with brown tint. Fins all pale. Iris gray. Length 81 to 92 mm., three examples.

ENGRAULIDIDÆ

Engraulis dussumieri (Valenciennes).

Depth 3⅔; head 3¾, width 2½ Snout 6 in head; eye 4⅓, greater than snout, equals interorbital; maxillary reaches ventral origin; interorbital 4⅓ in head. Gill rakers 17 + 18. Abdominal scutes 16 + 8. Dorsal rays iii, 9, I; Anal rays iii, 32, i, origin close behind base of last dorsal ray. Length 138 mm.

Engraulis valenciennesi (Bleeker).

Depth $3\frac{1}{2}$; head $4\frac{1}{3}$ to 5, width $2\frac{2}{5}$ to 5. Snout $5\frac{1}{2}$ to $5\frac{3}{4}$ in head ; eye $4\frac{1}{8}$ to $5\frac{1}{5}$, greater than snout and subequal with interorbital, lid not free ; maxillary reaches slightly beyond pectoral base, $3\frac{3}{4}$ to $3\frac{4}{5}$ in combined head and body, expansion $1\frac{1}{3}$ to $1\frac{2}{5}$ in eye ; interorbital 4 to $4\frac{1}{8}$ in head, convex. Gill rakers 10 + 14, lanceolate, slender, $1\frac{1}{4}$ in eye. Scales caducous, thin, cycloid, mostly fallen, 38 or 39 from above gill opening to caudal base and three more on latter, 12 or 13 transversely, 19 or 20 predorsal to occiput ; 6 to 10 vertical striæ, interrupted at median axis and circuli fine ; axillary pectoral scale slightly less than half of fin. Dorsal rays iii, 9, I, first branched ray $1\frac{1}{8}$ to $1\frac{1}{5}$ in head ; Anal rays iii, 41 to iii, 44, i, first branched ray $1\frac{1}{2}$; least depth of caudal peduncle $1\frac{7}{8}$ to 2 ; ventral $2\frac{1}{2}$ to $2\frac{2}{3}$; caudal forked, $3\frac{4}{5}$ to $3\frac{7}{8}$ in combined head and body ; pectoral $3\frac{7}{8}$ to $4\frac{1}{5}$.

Edge of back olivaceous brown, sides and below silvery white. Gray venulose area at shoulder moderate. Iris slate. Fins all pale or whitish, hind caudal edge gray. Length 150 to 177 mm., two examples.

Comparison with an example from Padang, Sumatra, shows it to vary as follows :—

Depth $3\frac{1}{3}$; snout 5 ; eye 4 ; maxillary expansion $1\frac{3}{5}$ in eye ; interorbital $3\frac{2}{3}$ in head. Gill rakers 12 + 17. Scales 10 transversely ; abdominal scutes 16 + 9. When fresh in arrack largely silvery, back dull olivaceous brown. Sides of head silvery white, also iris. No silvery lateral band. Humeral venules yellowish green, with horizontal waved line. Peritoneum silvery. Dorsal and caudal pale gray to dusky, medially tinged yellowish green. Other fins pale or whitish. Length 148 mm.

Engraulis tri, Bleeker.

Depth $4\frac{1}{3}$ to $4\frac{1}{2}$; head 4 to $4\frac{2}{5}$, width $2\frac{1}{4}$ to $2\frac{2}{5}$. Snout 5 to $5\frac{1}{3}$ in head ; eye $3\frac{2}{5}$ to $3\frac{2}{3}$, greater than snout, equals interorbital ; maxillary variably not quite to hind preopercle edge, usually not to gill opening, length $1\frac{1}{10}$ to $1\frac{1}{6}$ in head ; interorbital $3\frac{1}{4}$ to $3\frac{4}{5}$, very slightly convex. Gill rakers 15 + 25, finely lanceolate, twice gill filaments or equal eye. Scales very deciduous, all fallen, (pockets) 28 to 30 to caudal base and 2 or 3 more on latter, 9 transversely, 18 or 19 predorsal ; 4 or 5 vertical striæ with 10 or 11 reticulated marginally and circuli fine ; scutes 5 or 6 between pectoral and ventral. Dorsal rays iii, 12 or iii, 13, first branched ray $1\frac{1}{3}$ to $1\frac{1}{5}$ in head ; Anal rays iii, 15 to iii, 17, first branched ray $1\frac{2}{5}$ to $1\frac{3}{5}$, length of fin less than 5 in entire length of fish ; least depth of caudal peduncle $2\frac{1}{6}$ to $2\frac{1}{2}$; pectoral $1\frac{2}{5}$ to $1\frac{1}{2}$; ventral 2 to $2\frac{1}{8}$; caudal $3\frac{7}{8}$ to 4 in combined head and body.

Faded pale brownish. Iris light slate. Cluster of dusky dots on top of head posteriorly, row along dorsal base, edges of caudal peduncle and anal base. Indistinct diffuse whitish median lateral band from humeral region above to caudal base medially, widest along sides of caudal peduncle though greatest width not greater than eye. Fins all pale or whitish. Caudal greyish terminally. Length 53 to 63 mm., four examples.

Differs from the closely related *Engraulis indicus* Van Hasselt in the longer anal, which said to be $5\frac{2}{3}$ to 6 in total according to Weber and Beaufort.

Coilia dussumieri, Valenciennes.

Depth $4\frac{1}{3}$ to $5\frac{1}{5}$; head $4\frac{2}{3}$ to $5\frac{4}{5}$, width $2\frac{1}{6}$ to $2\frac{1}{3}$. Snout $4\frac{2}{5}$ to $5\frac{1}{8}$; eye $4\frac{1}{10}$ to $4\frac{1}{2}$, greater than snout, $1\frac{2}{5}$ to $1\frac{1}{2}$ in interorbital, without lids ; maxillary reaches nearly or quite to edge of gill opening, expansion 2 to $2\frac{2}{5}$ in eye, length $1\frac{1}{6}$ to $1\frac{1}{4}$ in head ; interorbital $3\frac{1}{8}$ to $3\frac{1}{3}$, broadly convex, cavernous. Gill rakers 20 + 23, lanceolate, slender, $1\frac{1}{8}$ in eye. Scales rather thin, caducous, cycloid ; 65 to 70 from above gill opening to caudal base, 10 or 11 transversely, 11 or 12 to occiput ; 5 or 6 largely radiating basal striæ and rest of scale with large, open reticulations, most distinct apically ; scutes 5 or 6+6 to 8, begin behind pectoral base. Dorsal fin iii, 10 to iii, 12, with small spine before dorsal, first branched ray $1\frac{1}{5}$ to $1\frac{1}{4}$ in head ; Anal rays iii, 98 to iii, 103, first branched ray $3\frac{1}{3}$ to $3\frac{2}{5}$; caudal $1\frac{1}{2}$ to $1\frac{2}{3}$, pointed ; Pectoral iv to vi, 8 to 11, filaments all free, reaching nearly or at least half way to caudal base, variably 4 to 6 even on same fish ; ventral $2\frac{1}{3}$ to $2\frac{2}{3}$, inserted opposite dorsal origin.

Faded largely very pale brownish, lighter below, evidently with silvery reflections in life. Fins all pale, gray on anal posteriorly and on caudal Iris slaty. Head with some brownish dots above. Length 160 to 178 mm., five examples.

These differ a little from Weber and Beaufort's figure in that the caudal is shown as $3\frac{1}{3}$ in head.

CONGRIDÆ

Uroconger lepturus (Richardson).

Depth 22 to 24 ; head $7\frac{3}{4}$ to 8, width 3. Combined head and trunk $2\frac{1}{4}$ to $2\frac{2}{5}$ to end of tail ; snout $3\frac{1}{2}$ to 4 in head ; eye 7 to 8, 2 to $2\frac{1}{5}$ in snout, greater than interorbital in young to $1\frac{1}{3}$ with age ; mouth cleft $2\frac{3}{5}$ to $2\frac{3}{4}$ in head, reaches beyond centre of eye though not quite opposite hind edge ; about 10 teeth on lower face of upper jaw external or before end of included lower jaw, upper laterals biserial also lower laterals but with short inner row anteriorly each side ; vomer with several large anterior teeth and median row of small ones down shaft ; front nostrils large, each side of snout end, with slight cutaneous rim and hind nostril rather large horizontal slit close before eye ; interorbital $6\frac{1}{5}$ to $8\frac{1}{2}$ in head, but little elevated, depressed. Gill opening $4\frac{2}{3}$ in head. Skin smooth. Close above and along upper lip 3 large horizontal slits. Dorsal begins over pectoral base, becomes higher than depth of tail posteriorly, which long, tapering and slender ; anal similar ; caudal about long as eye ; pectoral $4\frac{1}{4}$ to $5\frac{1}{3}$.

Brown, paler below on head and trunk. Iris slate. Lips whitish. Sides of head and body dusted with brownish. Dorsal, anal and caudal neutral blackish or former brown anteriorly. Pectoral pale. Length 222 to 348 mm., two examples.

MURÆNESOCIDÆ

Murænesox cinereus (Forskål).

Depth $23\frac{3}{5}$; head $7\frac{2}{5}$, width $4\frac{1}{5}$. Snout 4 in head ; eye $9\frac{3}{4}$, $2\frac{1}{2}$ in snout, greater than interorbital, center opposite last $\frac{2}{5}$ in mouth cleft, which $1\frac{1}{5}$ in head ; mandibular teeth erect ; interorbital II, slightly convex. Head and trunk combined $1\frac{2}{3}$ in tail. Caudal 6 in head ; pectoral 3. Drab gray, little lighter below. Vertical fins posteriorly dusky to blackish. Pectoral pale. Iris slate. Length 258 mm.

TACHYSURIDÆ

Osteogeniosus militaris (Linnæus).

Depth $4\frac{4}{5}$ to $5\frac{1}{5}$; head $3\frac{3}{4}$ to $3\frac{7}{8}$, width $1\frac{1}{3}$. Snout $2\frac{7}{8}$ to 3 in head ; eye $6\frac{1}{2}$ to $6\frac{2}{3}$, rather low and lateral, $2\frac{3}{5}$ to $2\frac{2}{3}$ in snout, $3\frac{4}{5}$ to $4\frac{2}{5}$ in interorbital ; mouth width $2\frac{2}{5}$ in head ; maxillary barbel to middle of pectoral spine ; broad band of villiform teeth in each jaw, of about 7 irregular rows ; on palate 2 broad semioval areas of obtuse, low teeth ; nostrils large, together, posterior little larger, both near snout end laterally ; interorbital $1\frac{4}{5}$ to $1\frac{7}{8}$ in head, elevated convexly ; median fontanel wide, not reaching occipital buckler, which twice wide at base as long and rugose striate, bony bridge complete to dorsal. Gill rakers 2 + 7, lanceolate, slender, $1\frac{3}{4}$ in gill filaments or 2 in eye. Skin smooth ; lateral line complete and median laterally. Dorsal fin with front and hind edges of spine antrorsely serrate, rays 7, first $1\frac{1}{3}$ to $1\frac{2}{5}$ in head ; adipose fin large, 2 ; Anal fin IV or V, 16, I, first branched ray $1\frac{7}{8}$ to 2 ; caudal $1\frac{1}{5}$, forked ; least depth of caudal peduncle 3 to $3\frac{1}{2}$; pectoral $1\frac{1}{2}$ to $1\frac{2}{3}$; ventral $1\frac{4}{5}$ to 2.

Back and head above nearly flax flower blue, below becoming pearl blue to white. Sides of head and body with obscure gray dots. Iris pale gray. Dorsal terminally gray, whitish basally. Adipose fin whitish, with gray above. Caudal pale to whitish, with gray above and below. Anal and paired fins whitish. Barbels pale. Length 158 to 180 mm., two examples.

Tachysurus sona (Buchanan-Hamilton).

Depth 5 ; head $3\frac{1}{4}$ to $3\frac{2}{5}$, width $1\frac{1}{6}$ to $1\frac{1}{5}$. Snout $2\frac{7}{8}$ to 3 in head ; eye 6 to $6\frac{1}{4}$, 2 to $2\frac{1}{4}$ in snout, $2\frac{2}{3}$ in interorbital ; mouth width $1\frac{9}{10}$ to 2 in head ; maxillary barbel reaches $\frac{3}{4}$ to $\frac{7}{8}$ in pectoral, outer mental $\frac{2}{5}$, inner mental $\frac{7}{8}$ or to pectoral origin ; bands of villiform teeth in jaws of about 5 or 6 transverse irregular series ; on palate 2 small closely approximated patches of villiform teeth and 2 large rounded posterior areas more separated ; interorbital little elevated convexly, width $2\frac{1}{5}$ to $2\frac{1}{2}$ in head ; head above and occiput striate ; occipital fontanel not quite reaching base of keeled occipital buckler, basal width of which 1⅕ its length, though bony bridge complete to dorsal. Gill rakers 5 + 10, lanceolate, 1¼ in gill filaments, which 1¼ in eye. Skin smooth. Lateral line complete, midway along side. Dorsal fin I, 7, compressed spine with antrorse serræ along front and hind edges, first ray 1¼ to 1⅓ in head; Anal fin IV, II, first branched ray $1\frac{9}{10}$ to 2; caudal forked, $1\frac{1}{10}$ to 1⅙; least depth of caudal peduncle 3⅞ to 4¼; pectoral 1⅕, compressed spine with outer and inner edges with antrorse serræ, 10 along inner edge; ventral 1⅞ to 2⅛.

Leaden gray, little paler below. Iris gray. All fins dusky to blackish terminally. Length 108 to 120 mm., two examples.

The above agree with Day's figure of an example 192 mm. shown with the front margin of the dorsal spine antrorsely serrate. They further show the lower front serræ more as close set granules.

Tachysurus cælatus (Valenciennes).

Depth 4⅗ to 4⅔; head 3⅔, width 1¼ to 1⅖. Snout 2¾ to 3 in head, eye 4⅘ to 6⅓, 1⅘ to 2⅗ in snout, 2 to 3½ in interorbital; mouth width 2⅙ to 2⅘ in head; maxillary barbel reaches ⅖ to ¾ in pectoral fin, outer mental to pectoral origin or ⅗ in fin and inner mental little shorter; teeth in villiform bands in jaws of about 5 or 6 irregular rows and ovate areas of similar teeth on each palatine; front nostril larger, close to snout end in profile and hind one about midway in snout, higher, without barbels; interorbital elevated convexly, 2 to 2⅔ in head; sides and upper surface of head, as occipital bones, buckler and humeral process rugose striate; broad occipital fontanel narrows behind and extends to base of keeled occipital buckler, base of which 1¼ its length and bony bridge complete to dorsal. Gill rakers 6 + 8, lanceolate, slender, 1⅛ in gill filaments or 2 in eye. Skin smooth; few venules on side of head and front of lateral line; lateral line complete anteriorly, in young many short waved venules. Dorsal fin I, 7, compressed spine with antrorse serræ along front and hind edges, with age most of lower serræ as granules, first ray 1¼ in head to 3⅖ in combined head and body with age; Anal 13 vii, or 14, first branched ray 1¾ to 1⅘ in head; adipose fin large, 2 in head; caudal I, forked; least depth of caudal peduncle 3⅘ to 4; pectoral 1 to 1¼, spine with antrorse serræ along both edges, 12 to 17 on inner; ventral 1⅗ to 1⅔.

Back dusky brown, lower surfaces white or soiled brownish. Young with back drab gray clouded with brownish; also along lower side of trunk and tail obscure brownish dustings. Fins all pale, blackish terminally with age. Barbels dusky. Length 90 to 163 mm., two examples.

Smaller example with a large isopod crustacean 21 mm. long, attached on the belly of the fish just before the ventrals. In my examples the dorsal spine ends in a long cutaneous filament.

PLOTOSIDÆ

Plotosus anguillaris (Bloch).

Depth 7; head 4½, width 1⅖. Snout 2½ in head; eye 7, 3 in snout, 2⅞ in interorbital; mouth width 2⅕ in head; teeth conic, triserial above medially to uniserial laterally, biserial below medially to uniserial laterally; maxillary barbel to eye centre, nasal barbel ⅔ to eye, outer mental barbel to middle of eye and inner mental barbel to front of eye; interorbital 2¾ in head, but slightly elevated and widely depressed. Gill rakers 8 + 23, lanceolate, equal gill filaments or eye. Skin smooth; lateral line complete, median on tail. Dorsal fin I, 5, first ray 2½ in head; second dorsal with about 82 rays; Anal fin 65 ?; caudal 3¼ in head; pectoral 2⅕; ventral 2⅛.

Brown, lighter to drab or whitish on lower surface of head and belly. Pale median lateral band from above maxillary to caudal base, another parallel from above eye along back. Fins all blackish brown, at least terminally, edges of vertical fins very narrowly whitish. Iris slate. Nasal and maxillary barbels brown, mentals whitish. Length 182 mm.

FISTULARIIDÆ

Fistularia villosa, Klunzinger.

Depth 1¼ in orbit, 15⅓ in head; head 2½ to caudal base, width about 8¾; snout 1⅓, from snout tip; eye 13⅓, 10 in snout; maxillary slightly longer than orbital socket, 8½ in snout; bony interorbital 2⅛ in eye. Gill rakers not developed or as few minute papillæ. Skin largely smooth to touch ; median vertebral row of narrow keels to dorsal about 36 and about 20 between dorsal and caudal ; similar ventral row from behind ventral to vent and behind anal to caudal. Lateral line distinct, with rough keel its whole length, showing 27 spines from opposite dorsal origin to caudal base. Dorsal rays 15, fifth ray $5\frac{1}{5}$ in total head length ; Anal rays 13, fifth ray $5\frac{2}{3}$; caudal $7\frac{1}{4}$, well forked, lobes pointed ; caudal peduncle depressed, least depth equals its least width or 4 in eye ; Pectoral rays 16, length $7\frac{2}{5}$ in total head length ; ventral $1\frac{1}{2}$ in eye.

Brown, beak and under surface paler. Iris slate. Caudal and filament with deep grayish, fins otherwise all pale. Length 335 mm. to caudal tip and filament 135 mm. longer.

It appears to agree in every way with an example from Natal except that its skin is smooth.

POLYNEMIDÆ

Polydactylus sextarius (Bloch).

Six examples, 74 to 130 mm. All have 7 pectoral filaments each side except one, which has 6 on the right side.

SCOMBRIDÆ

Scomberomorus kuhlii (Cuvier).

Depth $4\frac{1}{5}$ to $4\frac{1}{2}$; head $3\frac{1}{2}$ to $3\frac{3}{5}$, width $2\frac{7}{8}$. Snout $2\frac{4}{5}$ to $2\frac{7}{8}$ in head ; eye $4\frac{1}{10}$ to $4\frac{3}{5}$, $1\frac{2}{5}$ to $1\frac{1}{2}$ in snout, $1\frac{1}{10}$ in interorbital ; maxillary reaches opposite hind pupil edge, length $1\frac{2}{3}$ to $1\frac{7}{8}$ in head ; lower jaw slightly shorter ; teeth about 28 above, 34 below ; narrow band of fine teeth on each palatine and across vomer ; interorbital $3\frac{3}{8}$ to $3\frac{3}{4}$ in head, but slightly elevated convexly. Gill rakers 2 + 9, low, small, rudimentary tubercles. Scales not evident ; lateral line superior on trunk, midway along side of tail posterior to dorsal and anal lobes. Dorsal fin XVI—iii, 15 + 7, third spine $2\frac{2}{5}$ in head, first branched ray 3 to $3\frac{1}{10}$; Anal fin v, 14 + 7, first branched ray $2\frac{4}{5}$ to $3\frac{1}{4}$; caudal $1\frac{2}{5}$, widely forked ; least depth of caudal peduncle $6\frac{1}{10}$ to $6\frac{1}{2}$; pectoral $2\frac{3}{5}$ to $2\frac{3}{4}$; ventral $3\frac{1}{6}$ to $3\frac{1}{3}$.

Back clove brown, pale drab to whitish below. Iris pale slate. Fins all pale, spinous dorsal blackish anteriorly or over first 4 membranes at least. Length 61 to 78 mm., two examples.

These evidently the young, the adult described as uniform.

TRICHIURIDÆ

Trichiurus muticus, Gray.

Depth $15\frac{1}{3}$; head $8\frac{4}{5}$, width $5\frac{3}{4}$. Combined head and trunk $3\frac{3}{5}$ in tail ; snout $2\frac{3}{4}$ in head from snout tip ; eye 6, $2\frac{1}{8}$ in snout, greater than interorbital ; maxillary reaches eye, length $2\frac{3}{4}$ in head ; interorbital 8, convex. Gill rakers II + 16, very slender, short, $3\frac{1}{2}$ in gill filaments, which $1\frac{2}{5}$ in eye. Skin smooth ; lateral line slopes down to lower third in body depth at anal origin. Dorsal begins at first fourth between hind eye edge and pectoral origin, rays 112 so last fourth of tail free of rays, greatest dorsal height $2\frac{1}{8}$ to $3\frac{1}{4}$ in head including mandible tip ; Anal spines about 90, all low, short, little distinct, first one little developed or rudimentary ; pectoral 3 in head ; ventrals as 2 approximated small scales on ventral median line of abdomen posterior to head space equal to postocular region.

Brown above, sides and below silvery white. Iris slate. Length 361 mm.

Trichiurus savala (Cuvier).

Depth $21\frac{1}{4}$; head 8, width $5\frac{3}{5}$. Combined head and trunk $3\frac{3}{4}$ in tail ; snout $2\frac{3}{5}$ in head from snout tip ; eye 7, $2\frac{1}{2}$ in snout, greater than interorbital ; maxillary reaches opposite front pupil edge, $2\frac{1}{3}$ in head ; interorbital $8\frac{1}{5}$, depressed concavely. Gill rakers 5 + 9, short, very slender, $\frac{2}{5}$ of gill filaments or 4 in eye. Skin smooth ; lateral line slopes down to lower fourth in body depth at anal origin. Dorsal begins about midway between hind eye edge and pectoral origin, 115 rays so last $\frac{2}{5}$ of tail free of rays, greatest dorsal height $2\frac{1}{2}$ in total head length ; Anal spines 67, first equals eye, others all short though distinct; pectoral $2\frac{7}{8}$ in head ; no traces of ventrals.

Pale brown, with leaden to silvery reflections, edge of back slightly more brownish than rest of body. Iris slate. Fins whitish. Length 305 mm.

CARANGIDÆ

Caranx kalla (Valenciennes).

Eight examples, 82 to 114 mm.

Carangoides oblongus (Valenciennes).

Four examples, 38 to 55 mm. These show depth $1\frac{3}{4}$ and all are deeper than the Calicut example I reported. They also show 6 deeper gray vertical bands on the body, the vertical fins and ventrals with more or less dusky terminally, while pectoral alone entirely pale.

Apolectus niger (Bloch).

Four examples, 62 to 80 mm. For comparison one from Padang, Sumatra, 68 mm. long agrees in every way. Compared with the figure of *Apolectus stromateus* Cuvier[1] they agree in most every way except darker in colour, especially the fins. My larger examples show ventral $1\frac{1}{4}$ to $1\frac{3}{4}$ in head. Dorsal, anal and ventral blackish. Also caudal dusky gray on each lobe basally.

STROMATEIDÆ

Pampus cinereus (Bloch).

Depth $1\frac{1}{3}$ to $1\frac{1}{2}$; head 3 to $3\frac{1}{4}$, width 2. Snout $3\frac{3}{4}$ to 4 in head, protruded beyond mouth; eye $3\frac{3}{4}$ to 4, subequal with snout, $1\frac{1}{2}$ to $1\frac{3}{5}$ in interorbital; maxillary reaches front eye edge or eye center, length 2 to $2\frac{1}{3}$ in head; interorbital $2\frac{1}{8}$ to $2\frac{1}{4}$, greatly elevated convexly. Gill rakers 4 + 9, short points, about $\frac{1}{4}$ of gill filaments, which nearly equal eye. Scales extremely minute; lateral line arched, partly like dorsal profile of back, not extending beyond soft dorsal. Dorsal fin VIII, iii to v, 39, i or 40, i, short spines truncate terminally, longest ray $2\frac{2}{3}$ to $3\frac{1}{6}$ in combined head and body to caudal base; Anal V, iii to v, 33, i to 37, i, longest ray $2\frac{1}{8}$ to 3; caudal $2\frac{1}{5}$ to 3, strongly forked, lobes end in long, slender points; pectoral $2\frac{1}{6}$ to $2\frac{2}{3}$; least depth of caudal peduncle $3\frac{1}{8}$ to $3\frac{1}{2}$ in head.

Body drab brown, belly with gray tinge. Opercle with dusky tinge. Dorsal, anal and caudal with dusky tinge. Iris slate gray. Length 60 to 122 mm., 8 examples.

LEIOGNATHIDÆ

Secutor insidiator (Bloch).

Depth $2\frac{1}{10}$ to $2\frac{1}{6}$; head $3\frac{1}{5}$ to $3\frac{1}{3}$, width $2\frac{1}{8}$ to $2\frac{1}{6}$. Snout 3 to $3\frac{1}{4}$ in head from snout tip; eye 3 to $3\frac{1}{8}$, subequal with snout, greater than interorbital; maxillary reaches in vertical till below nostril, length 2 to $2\frac{1}{10}$ in head; interorbital $3\frac{1}{3}$ to $3\frac{2}{5}$, slightly convex; small antero-supraorbital spine; lower preopercle edge finely striate. Gill rakers 7 + 19, finely lanceolate, long as gill filaments or half of eye. Scales very minute, mostly fallen; lateral line nearly parallel with dorsal profile, reaches middle or little beyond in soft dorsal length. Dorsal fin VIII, 16, i, second spine $1\frac{2}{3}$ to $1\frac{7}{8}$ in total head length; Anal fin III, 14, i or 15, i, second spine 3 to $3\frac{1}{10}$; caudal I $1\frac{1}{10}$ to $1\frac{1}{8}$, forked; least depth of caudal peduncle $5\frac{2}{5}$ to $5\frac{1}{2}$; pectoral $1\frac{1}{4}$ to $1\frac{1}{2}$; ventral $2\frac{3}{5}$ to 3.

Pale brownish generally. On back above median axis of body dozen transverse dusky bars, each formed of 3 or 4 spots. Blackish streak from below eye and along maxillary sheath vertically. On trunk and tail below median axis sprinkling of dusky dots. Iris slate gray. Spinous dorsal broadly tipped black. Fins all pale, some grayish on caudal. Length 57 to 69 mm., four examples.

CHEILODIPTERIDÆ

Amia ellioti (Day).

Depth $2\frac{7}{8}$ to 3; head $2\frac{1}{5}$ to $2\frac{1}{4}$, width $2\frac{1}{4}$ to $2\frac{2}{3}$. Snout $4\frac{1}{2}$ to 5 in head from snout tip; eye $3\frac{3}{4}$ to $4\frac{1}{3}$, greater than snout or interorbital; maxillary reaches opposite eye center or hind eye edge, expansion $1\frac{1}{2}$ to $1\frac{4}{5}$ in eye, length 2 to $2\frac{1}{8}$ in head; narrow bands of minute teeth in jaws, on vomer and palatines; interorbital $4\frac{1}{4}$ to $4\frac{1}{2}$ in head, slightly convex; lower and hind preopercle edge rather weakly and irregularly denticulate, also but few weak points about angle of preopercle ridge. Gill rakers 4 + 11, uppermost as 3 rudiments, other slender, lanceolate, equal gill filaments or $1\frac{4}{5}$ in eye. Scales 23 or 24 in lateral line to caudal base and 2 or 3 more on latter, 2 above, 5 or 6 below, 3 predorsal; cheek with 2 rows, venulose, also opercles above and occiput with venules; 12 or 13 basal radiating striæ, small weak apical denticles 5 to 10 with 4 or 5 transverse series of basal elements and circuli fine. Dorsal fin VII—I, 8, i or 9, i, fourth spine $2\frac{3}{4}$ to $2\frac{4}{5}$ in total head length, third ray $1\frac{3}{5}$ to $1\frac{4}{5}$; Anal fin II, 7, i, or 8, i, second spine $3\frac{1}{2}$ to 4, third ray 2 to $2\frac{1}{5}$; caudal $1\frac{1}{2}$ to $1\frac{3}{5}$, little convex behind; least depth of caudal peduncle $2\frac{1}{2}$ to $2\frac{3}{5}$; pectoral $1\frac{4}{5}$ to $2\frac{1}{5}$; ventral $1\frac{9}{10}$ to 2.

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[1] *Hist. Nat. Poiss.*, *Atlas*, vol. 2, plate 258.

Uniformly pale brown. Iris slate. Dark streak from below eye on cheek. Top of head with dusky dots. Black median streak on chest. Outer $\frac{2}{5}$ of spinous dorsal black. Soft dorsal with dusky border and median horizontal dusky band. Anal with blackish median longitudinal band. Caudal grayish, with whitish submarginal band and black border. Ventral dusky basally and median dusky gray area. Length 77 to 105 mm., four examples.

Amia frenata (Valenciennes).

Depth $2\frac{3}{4}$; head $2\frac{2}{5}$, width $2\frac{1}{3}$. Snout $4\frac{1}{2}$ in head from snout tip; eye $3\frac{1}{4}$, greater than snout or interorbital; maxillary reaches opposite hind pupil edge, expansion 2 in eye, length 2 in head; teeth fine, minute, narrow bands in jaws, on vomer and palatines; interorbital 5, nearly level; preopercle edge minutely denticulate, ridge entire. Gill rakers 4 + 10, slender, lanceolate, twice gill filaments or $1\frac{4}{5}$ in eye. Scales 23 (pockets) in lateral line to caudal base and 2 more on latter, 2 above, 6 below, 5 predorsal; 2 rows on cheek; 15 basal radating striæ, 78 biserial apical denticles and circuli fine. Dorsal fin VII—I, 9, i, third spine $2\frac{1}{10}$ in total head length, first ray $1\frac{3}{4}$; Anal fin II, 8, i, second spine $2\frac{4}{5}$, second ray 2; caudal $1\frac{1}{5}$, emarginate; least depth of caudal peduncle $3\frac{1}{8}$; pectoral $1\frac{1}{2}$; ventral $1\frac{3}{4}$.

Pale drab brown generally, scales on back with dark edges, under surface paler. Dusky brown line from occiput till below end of soft dorsal. Dark brown band less than pupil in width from side of snout through eye across postocular to caudal base medially and out over caudal. Middle of side of head and body sprinkled with dusky dots. Fins all whitish, terminally grayish, also upper and lower caudal edges grayish. Pectoral uniform whitish. Iris slate. Mandible dusted with brownish terminally. Length 70 mm.

ACROPOMATIDÆ

Acropoma japonicum (Günther).

Depth 3; head $2\frac{1}{4}$, width $2\frac{3}{4}$. Snout 4 in head from snout tip; eye 4, greater than interorbital; maxillary reaches opposite first third in eye, length $2\frac{2}{3}$ in head, expansion 2 in eye; teeth fine, minute, in narrow bands in jaws, on vomer and palatines, also front pair of small canines in each jaw, depressible, lower smaller (accessory canine both above and below); interorbital $5\frac{1}{2}$ in head, level; preopercle ridge and edge entire. Gill rakers 6 + 14, slender, lanceolate, greater than gill filaments or 2 in eye. Scales very caducous, about 40 (pockets) in lateral line to caudal base, 4 above, 8 below, II predorsal; 4 rows on cheek; 4 to 6 basal radiating striæ, apical denticles 40 to 44, uniserial, small circuli fine; lateral line high along back, slopes down to caudal base medially. Dorsal fin VIII—I, 10, i, third spine $2\frac{1}{2}$ in total head length, first ray $2\frac{1}{10}$; Anal fin III, 7, i, third spine $4\frac{1}{6}$, first ray $2\frac{3}{4}$; caudal $1\frac{2}{5}$, forked; least depth of caudal peduncle $3\frac{3}{4}$; pectoral $1\frac{4}{5}$; ventral $2\frac{1}{2}$; vent at last $\frac{2}{5}$ in depressed ventral.

Drab gray above, below similar. Diffuse neutral slate area from pectoral base to base of lower caudal lobe. Iris gray. Fins all pale. Soft dorsal rays basally and rudimentary caudal rays sprinkled with dusky dots. Length 105 mm.

SPARIDÆ

Sparus spinifer Forskål.

One example 110 mm. Dorsal filaments reach emargination of caudal fin.

MULLIDÆ

Upeneoides vittatus (Forskal).

One example 147 mm. Differs a little from Day's figure in that the last membrane of spinous dorsal dusky or blackish. Dorsal with apex dusky or blackish. Soft dorsal also with apex dusky, then median longitudinal dusky band and finally imperfect basal dusky band which continues to end of last ray. Lower caudal lobe with 4 oblique dusky bands.

SCIÆNIDÆ

Otolithus ruber (Schneider).

One example 163 mm.

Johnius miles (Lacépède).

Dorsal $3\frac{1}{3}$; head 3, width $1\frac{9}{10}$. Snout $3\frac{1}{2}$ in head ; eye $4\frac{1}{6}$, $1\frac{1}{4}$ in snout, $1\frac{1}{10}$ in interorbital ; maxillary reaches opposite hind eye edge, expansion $1\frac{3}{4}$ in eye, length 2 in head ; bands of villiform teeth in jaws, above with outer row of rather wide spaced enlarged teeth, anteriorly 3 or 4 each side largest and all external to closed mandible; mandible also with outer row of enlarged well spaced teeth, though shorter than largest upper ones ; chin with 4 pits ; interorbital $3\frac{2}{3}$ in head, slightly convex ; preopercle edge denticulated. Gill rakers 6 + 14, lanceolate, equal gill filaments or half eye. Tubular scales 42 in lateral line to caudal base, each tube rather large, with short branch above and another below ; 7 scales above, 7 below, 25 predorsal ; 11 to 15 basal radiating striæ, apical denticles 32 or 33, with 5 to 7 transverse series of basal elements and circuli fine. Dorsal fin X1, 30, I, third spine $1\frac{7}{8}$ in head, first ray $2\frac{3}{5}$; Anal fin II, 7, i, second spine $2\frac{4}{5}$, second ray $1\frac{4}{5}$; caudal $1\frac{1}{2}$, obtusely cuneate ; least depth of, caudal peduncle 4 ; pectoral $1\frac{1}{3}$; ventral $1\frac{1}{2}$, first ray ending in short filament.

Back pale olive brown, below pale to whitish. Also back sprinkled with minute dusky dots and opercle also with dusky dots. Iris slate. Inside gill opening dusky. Spinous dorsal with membranes sprinkled with blackish. Soft dorsal with white base, greater outer portion of fin sprinkled with dusky gray. Caudal grayish. Other fins whitish. Length 92 mm.

Johnius glaucus (Day).

Depth $3\frac{1}{8}$ to $3\frac{3}{4}$; head $2\frac{7}{8}$ to $3\frac{1}{2}$, width $1\frac{4}{5}$ to 2. Snout $3\frac{1}{8}$ to $3\frac{1}{2}$ in head ; eye $3\frac{1}{2}$ to $4\frac{1}{4}$, 1 to $1\frac{2}{5}$ in snout, 1 to $1\frac{1}{4}$ in interorbital ; maxillary reaches $\frac{2}{5}$ to $\frac{1}{2}$ in eye, expansion $1\frac{4}{5}$ to 2 in eye, length $2\frac{2}{5}$ to $2\frac{4}{5}$ in head ; chin with 5 pores ; interorbital $3\frac{1}{2}$ to 4, broadly convex ; preopercle edge denticulate. Gill rakers 5 or 6 + 12 or 13, lanceolate, short, half of gill filaments, which half of eye. Tubular scales 45 to 47 in lateral line to caudal base, 6 scales above, 7 to 9 below, 19 to 24 predorsal forward nearly to snout tip ; 8 basal radiating striæ, apical denticles 22 to 28 with 8 or 9 transverse series of basal elements and circuli fine ; each tube of lateral line with short branch above and below. Dorsal fin XI, 27, i to 32, i, second spine $1\frac{3}{5}$ to 3 in head, third ray $2\frac{2}{5}$ to $2\frac{1}{2}$; Anal fin II, 7, i, second spine $2\frac{1}{10}$ to 3, first ray $1\frac{1}{2}$ to $1\frac{3}{4}$; caudal 1 to $1\frac{1}{8}$, cuneate ; least depth of caudal peduncle $3\frac{1}{3}$ to 4 ; pectoral $1\frac{1}{4}$ to $1\frac{1}{2}$; ventral $1\frac{1}{5}$ to $1\frac{3}{5}$, ends in short filament.

Mauve brown above, paler to whitish below. Iris slate. Inside gill opening neutral dusky. Opercle neutral brown. Spinous dorsal dusky terminally, soft dorsal and caudal grayish, other fins whitish ; sometimes vertical fins all more or less dusky to dusky gray terminally. Sometimes paired fins sprinkled with dark dots. Pectoral with gray blotch within axil close behind origin of fin. Length 70 to 114 mm., seven examples.

Johnius belangeri (Cuvier).

Depth $3\frac{2}{5}$ to $3\frac{1}{2}$; head $3\frac{1}{3}$ to $3\frac{4}{5}$, width $1\frac{4}{5}$ to 2. Snout $3\frac{1}{4}$ to $3\frac{1}{2}$ in head ; eye $3\frac{4}{5}$ to $4\frac{1}{8}$, $1\frac{1}{4}$ to $1\frac{1}{2}$ in snout, equals interorbital ; maxillary reaches opposite eye centre, expansion $2\frac{1}{5}$ in eye, length 3 to $3\frac{1}{10}$ in head ; outer row of upper teeth slightly enlarged, lower uniform ; chin with 5 pores ; interorbital $3\frac{4}{5}$ to $4\frac{1}{8}$ in head, broadly convex ; preopercle edge flexibly serrate. Gill rakers 4 + 9, short, lanceolate, half of gill filaments, which $2\frac{2}{5}$ in eye. Tubular scales 43 to 47 in lateral line to caudal base, 6 or 7 scales above, 8 or 9 below, 23 or 24 predorsal ; 7 to 10 basal radiating striæ, apical denticles 31 to 37 with 2 or 3 transverse series of basal elements and circuli fine. Dorsal fin IX or X, 29, i or 30, i, third spine $1\frac{3}{4}$ to 2 in head, first ray $2\frac{3}{5}$ to $2\frac{2}{3}$; Anal fin II, 8, i or 9, i, second spine $2\frac{1}{8}$ to $2\frac{1}{4}$, second ray $1\frac{1}{2}$ to $1\frac{3}{5}$; caudal I, cuneate, ends in median point ; least depth of caudal peduncle $3\frac{1}{5}$ to $3\frac{1}{4}$; pectoral $1\frac{1}{5}$ to $1\frac{1}{3}$; ventral $1\frac{1}{8}$ to $1\frac{1}{5}$, first ray ends in filament.

Brown above, below whitish. Spinous dorsal, anal and ventral more or less blackish terminally, other vertical fins dusky terminally. Pectoral pale brown. Iris slate. Length 100 to 114 mm., two examples.

Sciæna russellii (Cuvier).

Depth $3\frac{1}{4}$ to $3\frac{1}{3}$; head 3 to $3\frac{1}{8}$, width $2\frac{1}{8}$ to $2\frac{1}{5}$. Snout $3\frac{2}{5}$ to $3\frac{3}{4}$; eye $3\frac{1}{2}$ to 4, subequal with snout, slightly greater than interorbital; maxillary reaches $\frac{3}{5}$ to $\frac{2}{3}$ in eye, expansion $2\frac{2}{5}$ to $2\frac{3}{4}$ in eye, length $2\frac{3}{4}$ to $2\frac{4}{5}$ in head; mandibular barbel $1\frac{3}{5}$ in eye, 2 pores each side; bands of minute villiform teeth in each jaw, palate edentulous; interorbital $4\frac{2}{5}$ to $4\frac{1}{2}$ in head, slightly convex; preopercle edge denticulate. Gill rakers 6 + 10, low, short points, $1\frac{1}{2}$ in gill filaments which $2\frac{1}{4}$ in eye. Tubular scales 45 in lateral line to caudal base, 7 above, 8 below, 28 predorsal; anteriorly in lateral line each tube with 2 short branches; basal radiating striæ II, apical denticles 25 or 26 with 7 or 8 transverse series of basal elements and circuli fine. Dorsal fin XI, 26, i or 27, i, third spine $2\frac{1}{10}$ to $2\frac{1}{3}$ in head, first ray $2\frac{1}{4}$ to $2\frac{2}{5}$; Anal fin II, 7, i, second spine $2\frac{1}{3}$ to $2\frac{2}{5}$, first ray $1\frac{3}{4}$ to $1\frac{7}{8}$; caudal $1\frac{1}{10}$ to $1\frac{1}{8}$, cuneate; least depth of caudal peduncle 3 to $3\frac{1}{4}$; pectoral $1\frac{1}{2}$ to $1\frac{3}{5}$; ventral $1\frac{2}{5}$ to $1\frac{1}{2}$.

Light brown generally, little paler below, back and head above dusted with dusky brown. Opercle largely dusky. Iris slate. Barbels pale or whitish. Spinous dorsal largely blackish over upper portions. Soft vertical fins with grayish on outer portions. Paired fins whitish.

EPHIPPIDÆ.

Drepane punctata (Gmelin).

Three examples, 68 to 70 mm.

GOBIIDÆ

Trypauchen vagina (Schneider).

Depth $7\frac{4}{5}$ to $8\frac{7}{8}$; head $5\frac{1}{2}$ to $5\frac{1}{2}$, width $2\frac{1}{6}$ to $2\frac{1}{4}$. Snout 4 to $4\frac{1}{6}$ in head from snout tip; eye $11\frac{1}{2}$ to 12, $2\frac{3}{4}$ to $3\frac{1}{4}$ in snout, $1\frac{3}{4}$ to 2 in interorbital; maxillary reaches opposite eye, 3 to $3\frac{1}{8}$ in head; band of fine teeth in each jaw and outer row of enlarged ones, lower larger and as pair of anterior canines and several laterals; interorbital $6\frac{1}{4}$ to 7, convex. Gill rakers 1 + 5, short, low, rudimentary papillæ. Scales 70 to 75 between gill opening in median lateral series to caudal base, 15 to 17 transversely at anal origin; predorsal largely scaleless; 12 or 13 basal radiating striæ, circuli moderately fine. Dorsal fin VI, 48 to 50, height $3\frac{3}{4}$ to 4 in total head length; Anal fin 48, height $3\frac{3}{4}$ to $4\frac{2}{5}$; least depth of caudal peduncle 3 to $3\frac{1}{5}$; pectoral $2\frac{7}{8}$ to $3\frac{3}{4}$; ventral 3 to $3\frac{1}{2}$.

Light gray brown generally. Iris grayish. Fins all pale brown. Length 113 to 137 mm., three examples.

PLEURONECTIDÆ

Pseudorhombus russellii, Gray.

One example, 110 mm.

SOLEIDÆ

Paraplagusia bilineata (Bloch).

Depth 4; head 4, width $4\frac{3}{5}$. Snout to upper eye $2\frac{2}{5}$ in head; upper eye $10\frac{1}{4}$, advanced $\frac{3}{4}$ its diameter from lower eye, $4\frac{3}{4}$ in snout, equals interorbital; mouth cleft $4\frac{1}{2}$ in head, little curved, rictus reaching opposite hind eye edge; left (colored side) lips each with fringe of fleshy tentacles, lower better developed and right lips entire; rather broad band of villiform teeth on right side of each jaw, left side edentulous. No gill rakers. Scales 76 in median lateral line from opposite end of hind edge of gill opening to caudal base, 14 above median lateral line to upper and 22 below to lower body edge; no lateral line on right side; left scales with 22 to 25 basal radiating striæ, apical denticles 21 to 23, large and 4 or 5 transverse series basally, circuli fine; right scales with 27 to 29 radiating striæ, 19 to 21 large apical denticles and circuli fine; small scales crowded along body edges and over caudal basally. Dorsal fin 98, height $3\frac{7}{8}$ in head; Anal fin 73, height 4; caudal $2\frac{1}{4}$, pointed.

Left side brown clouded little with darker. Fins all deeper brownish. Right side pale. Length 130 mm.

Cynoglossus macrolepidotus (Bleeker).

Two examples 144 to 167 mm. Scales 52 to 58 in median lateral line counted from opposite hind edge of gill opening.

BREGMACEROTIDÆ

Bregmaceros atripinnis (Tickell).

Depth $6\frac{1}{8}$ to $6\frac{1}{4}$; head $5\frac{4}{5}$ to 6, width $1\frac{3}{4}$ to $1\frac{4}{5}$. Snout 4 in head from snout tip ; eye 4, equals snout, $1\frac{1}{3}$ to $1\frac{2}{3}$ in interorbital ; maxillary reaches $\frac{2}{3}$ to $\frac{3}{4}$ in eye, length $2\frac{1}{5}$ to $2\frac{1}{4}$ in head ; narrow bands of fine teeth in jaws and large examples with narrow bands across vomer but none on palatines ; interorbital $2\frac{7}{8}$ to 3, convex. No gill rakers. Scales 63 to 64 in median lateral series from above gill opening to caudal base, 16 or 17 transversely ; no lateral line ; scales with moderate circuli, all ending marginally basally and narrow interspace between each line studded with minute rugosities. Dorsal fin 1—56 to 60, dorsal spine $3\frac{3}{4}$ to $4\frac{1}{6}$ in combined head and body, height of rayed dorsal $4\frac{2}{5}$ to $4\frac{3}{5}$; Anal fin 55 to 58, height $4\frac{2}{5}$ to $4\frac{1}{2}$; caudal $1\frac{3}{5}$ to $1\frac{3}{4}$ in head ; least depth of caudal peduncle $3\frac{3}{4}$ to 4 ; pectoral $1\frac{1}{6}$ to $1\frac{1}{4}$.

Brown, back with each scale pocket bordered with dusky dots so whole back above darker. Under surface of body whitish. Head grayish. Iris slate gray. Front dorsal lobe blackish, rest of fin with dusky, at least terminally. Anal whitish, terminally lobe blackish and fin grayish posteriorly. Cauda dusky gray. Pectoral blackish. Ventral white. Length 73 to 93 mm., four examples.

TETRODONTIDÆ

Sphœroides lunaris (Schneider).

Depth (retracted) $2\frac{7}{8}$; head $2\frac{3}{5}$, width $1\frac{3}{5}$. Snout $2\frac{1}{5}$ in head ; eye $3\frac{1}{4}$, $1\frac{1}{2}$ in snout, $1\frac{3}{4}$ in interorbital ; mouth width $3\frac{3}{5}$ in head ; interorbital $2\frac{3}{4}$, broadly convex ; gill opening $3\frac{2}{5}$. Top of head from behind nostrils and predorsal finely spinescent, also inflatable abdomen below, body otherwise smooth ; slight lateral fold along lower side of tail ; lateral line high at first, drops midway on tail behind dorsal and anal lobes. Dorsal fin II, II, first branched ray 2 in head ; Anal fin II, 10, first branched ray 2 ; caudal $1\frac{2}{5}$, lunate ; least depth of caudal peduncle $5\frac{1}{5}$; pectoral $1\frac{7}{8}$.

Drab above, grayish to whitish below. Iris slaty. Fins pale brownish, pectoral and anal whitish. Length 77 mm.

Sphœroides viridipunctatus (Day).

Depth (retracted) $2\frac{1}{2}$ to $2\frac{3}{4}$; head $2\frac{3}{4}$ to $2\frac{4}{5}$, width $1\frac{1}{4}$ to $1\frac{2}{5}$. Snout $2\frac{1}{10}$ to $2\frac{1}{4}$ in head ; eye 4 to $5\frac{1}{5}$, $1\frac{7}{8}$ to $2\frac{7}{8}$ in snout, $2\frac{1}{3}$ to 3 in interorbital ; mouth width $3\frac{7}{8}$ to $4\frac{1}{4}$ in head ; nasal aperture large, with short cutaneous rim ; interorbital $1\frac{9}{10}$ to $2\frac{1}{10}$, broadly convex, depressed medially. Gill opening $3\frac{1}{3}$ to 4 in head. Occiput from behind interorbital space about half-way in predorsal with fine spinules ; abdomen up till level with lower pectoral base and backi about eye diameter to snout length before vent with fine spines, body otherwise naked ; lateral line arched high to predorsal, falls median on side of cauda peduncle posteriorly. Dorsal fin iii, 7, i, or iii, 8, i, first branched ray $1\frac{7}{8}$ to 2 in head ; Anal fin ii, 6, i or i, 7, ii, first branched ray $2\frac{1}{5}$ to $2\frac{1}{2}$; caudal $1\frac{1}{4}$ to $1\frac{2}{5}$, truncate ; least depth of caudal peduncle $2\frac{4}{5}$ to 3 ; pectoral 2 to $2\frac{1}{8}$.

Back gray brown, lower sides and under surface whitish. Sides with dark reticulations leaving many rather large pale longitudinal whitish spots. Fins all pale. Caudal blackish terminally. Iris slate gray. Length 64 to 102 mm., three examples.

Apparently the young, these examples differ in that Day describes the nostrils as 2 solid tentacles. Likewise they do not show 4 black spots under the throat or the anal tipped with black. There is however the median transverse pale band across the posterior interorbital. Some also show a dark blotch before the dorsal.

Leiodon cutcutia (Buchanan-Hamilton).

Depth (retracted) 3 ; head $2\frac{1}{2}$, width $1\frac{1}{4}$. Snout $2\frac{3}{4}$ in head ; eye $4\frac{3}{4}$, $1\frac{3}{4}$ in snout, $2\frac{1}{10}$ in interorbital ; mouth width $4\frac{1}{2}$ in head ; nasal tube bilobate : interorbital $2\frac{1}{4}$, broadly convex ; gill opening $4\frac{1}{2}$. Skin entirely smooth, Dorsal fin I, 15, sixth branched ray $2\frac{1}{6}$ in head ; Anal fin I, 12, sixth branched ray $2\frac{1}{10}$; caudal $1\frac{2}{5}$, truncate ; least depth of caudal peduncle $2\frac{1}{2}$; pectoral 2.

Gray brown above, clouded darker. Side medially with more or less whitish, marked with many rather large rounded blackish brown spots. Belly before vent blackish. Faint light band across interorbital. Iris slate gray. Fins all pale brownish and caudal blackish terminally. Length 103 mm.

ANTENNARIIDÆ

Antennarius hispidus (Schneider).

Depth $1\frac{3}{4}$ to $1\frac{4}{5}$; head $1\frac{1}{2}$, width $2\frac{1}{4}$ to $2\frac{3}{4}$. Snout $5\frac{1}{2}$ to $5\frac{4}{5}$ in head from snout tip ; eye 10 to $12\frac{1}{2}$, 2 in snout, $2\frac{1}{5}$ to $2\frac{1}{4}$ in interorbital ; maxillary $2\frac{7}{8}$ to $3\frac{1}{4}$ in head ; mouth width $2\frac{3}{4}$ to $2\frac{4}{5}$; interorbital $4\frac{1}{2}$ to $4\frac{2}{3}$, convex. Gill opening equals eye. Skin covered with wide set villose points. Dorsal fin I–I–I–11 or 12, first spine depressed equals length of second spine, with fleshy terminal bulb ; Anal fin 7 ; pectoral 9 to 11 ; ventral 5.

Drab brown, slightly paler below. Back and sides above with variable dusky to blackish brown lines or bands, more or less vertical and others radiating from eye, also some breaking in places to spots and bars. Dorsal, anal and caudal more or less spotted with blackish. Iris pale slate. Ventral with several dusky spots. Length 52 to 55 mm., three examples.

THE MOGHUL EMPERORS OF INDIA AS NATURALISTS AND SPORTSMEN

BY

SALIM A. ALI

PART III

(Continued from page 63 of this volume.)

REPTILES

THE CROCODILE

Babur [1] mentions that " One of the aquatic animals is the *Sherābi* (i. e. ' Water lion '). It dwells in standing waters (i.e. lagoons left on the banks of the great rivers after an inundation, etc.) and resembles the *Gilas* (lizard). They say it carries off men and even buffaloes.

" Another is the *Sipsar*.[2] This too is like the crocodile. It inhabits all the rivers of Hindustan. One was caught and brought to me. It may be four or five *gaz* (10 or 12½ feet) in length and some are even larger. Its snout is upwards of half a *gaz* long. Both in its upper and lower jaw it has several very small ranges of teeth. It comes out and sleeps on the edge of the water."

The reference no doubt is to the two species of crocodiles found in India, viz. the Marsh Crocodile (*Crocodilus palustris*) and the Estuary Crocodile (*C. porosus*), though it is difficult to ascribe the species with any certainty. The former is the common crocodile of our inland waters and attains an average length of 12 ft. while the latter, in India, is practically confined to the East Coast and is reputed to grow up to 33 ft.

Babur continues: " The Gharial is a large fish. Many of the army saw it in the River Saru (Gogra). It carries off men. During the time we remained on the River Saru, one or two slave boys were siezed by it and carried down. Between Ghazipur and Benares it also carried off 2, 3 or 4 of our men. In that vicinity I saw a gharial from a distance, but I could not get a distinct view of it."

There is a general belief that the Gharial (*Gavialis gangeticus*) lives exclusively on small fish, and in fact the structure of its mouth apparently is not such as to admit of its negotiating larger prey. The discovery however, of brass rings, bangles and other human adornments in its stomach from time to time, indicates that it can thrive comfortably enough on human food, and Babur's records of its appropriating several of his men may be quite in order, though it is equally possible that these finds may be attributed to the reptile's habits of feeding on corpses. An instance of human ornaments being found in a gharial's stomach along with the entire hind quarters of a donkey is recorded on page 703, vol. xxx of the Society's Journal. The slender character of the gharial's snout and its comparatively fine teeth seem little adapted to the pulling down and overpowering of larger animals such as might easily fall a prey to the mugger.

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[1] *Babur*, vol. ii, p. 223.

[2] As King suggests, this may be a corruption of *Siyah-sar* (" Black head ") the Persian for Crocodile.

The Jesuit Fr. Monserrate writing during Akbar's reign of the Sutlej states : " This river contains crocodiles. They are called *cissares*, that is ' three headed '. They have six feet on which they crawl, and they swallow unawares from below when they are swimming in the water. They sieze by the foot and drag down under water oxen, buffaloes and sheep and other animals whilst drinking at the side of the river."

The name *cissares* which the worthy Father interprets as " three headed" is I think obviously a corruption of *Sipsar* or *Siah-sar*, the Persian for crocodile and has nothing whatsoever to do with "three". The description of this amazing six-legged monster leaves one wondering if Monserrate's accounts of other things and his " facts " are equally fanciful. As this writer is frequently accepted as an authority and a " source " by historians, one can only hope, in fairness to the times, that on other matters not so simple to verify he is slightly more reliable.

There is only one solitary record I have been able to discover of the crocodile being hunted by the Moghul Emperors. Jehangir[1] chronicles from the city of Dhar as follows :—" On Tuesday the 7th, I shot a crocodile in the tank of Dhar. Though only the top of his snout was visible, and the rest of his body was hidden under water, I fired at a guess and hit him in his lungs and killed him with a single shot. A crocodile is of the lizard (?) species and exists in most of the rivers of Hindustan, and grows very large. This was not so very big. A crocodile has been seen by me 8 *gaz* (20 feet) long and 1 *gaz* (2½ feet) in breadth."

SNAKES

Abul Fazl writes that in the Sarkar of Kashmir "Snakes, scorpions and other venomous reptiles are not found in the cities. There is a mountain called Mahadeva, and in any spot whence its summit can be seen, no snake exists."

One day while the Emperor Akbar was hunting in the forests of Narwar (now in Bhopal State), his historian narrates that " His eye fell upon a serpent which was nearly 7 Akbar Shahi yards in length, and which had consumed several cheetal, which are a kind of deer, and was about to destroy more. His Majesty ordered the noxious animal to be destroyed, so that it received retribution for its actions."

The Akbar Shahi *gaz* according to Jarrett[2] was 41 fingers long. The maximum length attained by the Indian species is about 20 feet.

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[1] *Jeh.*, vol. i, p. 408.

[2] *Ain.*, vol. ii, p. 61.

Jehangir relates that one day while hunting in the neighbourhood of Aligarh he came upon a snake the length of which was 2½ yards and its girth equal to three cubits (*dast*) "He had swallowed half a hare," he notes "and was in the act of swallowing the other half. When the huntsman picked him up and brought him to me the hare fell out of its mouth. I ordered them to put it into its mouth again, but they could not do it however much they exerted themselves ; but by using great violence the corner of its mouth was torn to pieces. After this I ordered them to open its belly. Thereupon another entire hare came out. They call this kind of snake *Chital* in Hindustan, and it grows so large that it swallows a *kotah-pacha* (Hog deer) entire, but it is not poisonous and does not bite."

The snake referred to is again manifestly our Indian Python (*Python molurus*).

Jehangir writes that on occasion one (*circa* A.D. 1624) while hunting, it was reported to him that a snake with a black hood (*kafcha*) had swallowed another hooded snake and gone into a hole. He ordered that it should be dug up and brought to him. "Without exaggeration," he continues, "I had never seen a snake of this size (length ?) When they opened its belly the hood of the snake it had swallowed came out whole. Although this snake was of another kind, in length and girth little difference was visible."

It is possible that the former may have been an example of the King Cobra (*Naia hannah*). Col. Wall[1] states that the staple diet of this species is snakes. He has records of its practising cannibalism and also of devouring several poisonous species including the Cobra and Banded Krait. It often swallows snakes of its own size.

According to Niccolao Manucci, popularly known as the "Pepys of Moghul India," poisonous snakes were employed at the court of the Emperor Shah Jehan in an ingenious though somewhat gruesome manner for the suppression of official corruption and *zulum*. He writes,[2] "He (the Emperor) kept his eye on the officials, punishing them rigorously when they fell short of their duty. This was the reason he kept at his court an official with several baskets full of poisonous snakes. He would order that in his presence they should be made to bite an official who had failed to administer justice leaving the culprit lying in his presence till the breath left him." Manucci had an opportunity of witnessing the execution thus of a *kotwal* or magistrate who had been found guilty of taking bribes and not acting uprightly in the discharge of his duties. "An order was given," he writes, "that he should be bitten in one hand in the Emperor's presence by a Cobra capello, the most poisonous snake on earth. The official in charge of the snakes was asked how long the man could live. The official replied that he could not live more than an hour. The king remained seated till the *kotwal* expired. He then ordered that the body should lie two days in front of his court house. . . ."

An extraordinary occurrence is narrated by the same writer, which *if* it has any bearing on actual facts, is difficult to interpret or explain. It would appear to be something in the nature of a snake migration and I quote it *in extenso* for what it is worth.

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[1] *Journal, B. N. H. S.*, vol. xxx, p. 192.

[2] *Storio do Mogor*, vol. i, p. 197.

Manucci[1] writes: "During the time that Prince Shah Shuja (one of Shah Jehan's sons) governed the kingdom of Bengalla (Bengal) where he held his principal court in the city of Rajmahal, there happened, a few years before the rebellion in the Moghul kingdom, an extraordinary case about which he (the prince) wrote to king Shah Jehan. At eight o' clock in the day there appeared near the said city, in a plain a league and a half broad, a great number of cobra snakes large and small. They covered the field and moved from west to east until four o'clock in the afternoon; they looked like ripples in the ocean. In the greatest fright the inhabitants of the village climbed upon the tops of their houses and upon trees. They beheld moving in the midst of the said cobras one of great size which carried on its head another smaller one entirely white. They pursued their way without harming any one, many remaining behind in the suburbs of the city and in the villages and through losing their companions they died. Hearing of this event, Shah Jehan asked his astrologers what it meant. They replied that the wickedness of the empire was taking its departure and that he would survive for many prosperous years. The prince Shah Shuja also consulted his astrologers and they told him that before much time had passed there would arise a rebellion in the empire and that he would become emperor. The little cobra carried upon the head of the large one was, they said, the king of the cobras who had come to the end of his reign and was thus compelled to leave his abode."

Which shows that then as now, there were two sides to every question!

BATRACHIANS

Frogs

Babur writes: "The frogs of Hindustan are worthy of notice. Though of the same species as our own, yet they will run 6 or 7 *gaz* on the face of the water."

Dr. Annandale in his paper "The Animal Life of the Ganges" which appeared in vol. xxix, No. 3 of the Society's Journal, says, "Babur was the first to describe a peculiar habit of the commonest of our North Indian frogs *(Rana cyanophlyctis)* which skips lightly along the surface of the water when disturbed."

Abul Fazl says, "Frogs also may be trained to catch sparrows. This looks very funny." One of the favourite amusements of the Emperor Akbar was to watch these trained frogs in action.

Such propensity in the frog may sound incredible but recent observations confirm that our Bull Frog (*Rana tigrina*), is capable of the performance even without a special course of instruction. E. H. Aitken[2] once found an adult sparrow inside one of these creatures, which appears when favoured by opportunity, to devour birds. The same observer records that on three occasions he has known a Bull Frog try to swallow a chicken at least a week old, while J. A. Betham [1] has actually seen a Bull Frog swallowing a chicken, and on one occasion took from the jaws of this batrachian a Pitta (*Pitta brachyura*).

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[1] *Storio do Mogor*, vol. i, p. 288.

[2] *J.B.N.H.S.*, vol. ix, p. 500.

FISHES

On the subject of the Fishes of Hindustan, Babur [2] remarks follows: " Their flesh is delicate and they have few small bones. They are surprisingly active. On one occasion a net was laid in the river from side to side. Each side of the net was then raised a *gaz* (2½ ft.) above the water, yet many of the fish leaped one after the other a full *gaz* over the net and escaped. There are besides in many rivers of Hindustan small fishes which if they hear a harsh sound or the treading of a foot instantly leap a *gaz* or a *gaz* and a half out of the water."

I have had occasion to witness fish with this last mentioned peculiarity taken on the River Phuleli, a tributary of the Indus near Hyderabad. A British soldier was paddling along in a dug-out and producing a grating sound in some unknown manner, whereupon the fish leaped out and were promptly held by the man in his regulation helmet! The performance was amusing to watch.

The identity of a fish described by Babur in the following terms is a mystery. Sir Lucas King has made no comment on it, and it is surprising that such a singular animal, *if* it exists, should not be generally known. I can find no reference to anything like it in Dr. Annandale's paper either. " One fish in the *Kakeh.* On a line with its two ears issue two bones, three fingers-breadth in length. When caught it shakes these two bones which return a singular sound, whence they have given this fish its name of *Kakeh.* "

Abul Fazl[3] mentions that fishing was much pursued in the Sarkar of Tattah (Sind). "There is" he writes, " a kind of fish called *Palwah* which comes up into the Indus from the sea, unrivalled for its fine and exquisite flavour. "

This species, which regularly ascends the Indus in February and March in enormous swarms for the purpose of spawning, and highly prized as an article for the table, is *Clupea ilisha*, a sea-fish of the same genus as the Herring and known in Bengal as the Hilsa.

Jehangir was partial to the sport of fishing and his " bags " are recorded in his *Memoirs* from time to time. On one occasion he relates catching (netting) 766 fish which were distributed in his presence among his amirs and servants.

While in Kashmir, he paid a visit to Virnag, the source of the River Jhelum, and records that on the return journey he passed by a spring called Andha Nag (i. e. Blind fountain). " It is well known," he writes, " that the fish in this fountain are blind. I delayed a while near the spring and threw in a net and caught 12 of the fish. Of these 3 were blind and 9 had eyes. Evidently the water of the spring has the effect of making them blind. Certainly this is not devoid of interest."

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[1] *J.B.N.H.S.*, vol. x, p. 695.

[2] *Babur*, vol. ii, p. 224.

[3] *Ain*, vol. iii, p. 338

Further, Jehangir[1] mentions: " I have a great liking for fish, and all kinds of good fish are brought for me. The best fish in Hindustan is the *Rohu* and after that the *Barin*. Both have scales and in appearance and shape are like each other. Everyone cannot at once distinguish between them. The difference in their flesh also is very small but the connoiseur discovers that the flesh of the *Rohu* is rather more agreeable of the two."

The *Rohu* is *Labeo calbasu* and the other possibly the Indian Trout (*Barilius bola.*)

Silk worms

Among other things found in the district of Kumaon, Abul Fazl mentions a profusion of silk worms, and at a later date Jehangir observes [2] that in Kashmir " there are no *Shaḥ-tūt* (a kind of large mulberry) but there are *Tūt* (mulberries) everywhere. From the foot of every mulberry tree a vine creeper grows up. In fact the mulberries of Kashmir are not fit to eat, with the exception of some trees grown in gardens, but the leaves are used to feed the silk-worm. They bring the silk-worms' eggs from Gilgit and Tibet."

Sericulture in India is an industry of great antiquity. Marco Polo mentions it as flourishing in Turkestan and China in the thirteenth century and both these countries exported silk in large quantities.

Gnats, Fleas, Lice, etc.

According to Abdul Fazl, all these undesirables were to be found in plenty in the Sarkar of Kashmir.

" Black Bee " (*Xylocopa amethystina*)

After a description of the lotus and kamudini flowers, Jehangir goes on to this insect regarding which he observes as follows [3] " The black bee which the people of India call ' Bhaunra ' always sits on these flowers, and goes inside them to drink the juice that is in both of them. It often happens that the flower closes and the bee remains in it the whole night. In the same manner it remains in the kamudini flower. When the flower opens, it comes out and flies away. As the black bee is a constant attendant on these flowers, the poets of India look on it as a lover of the flower, like the nightingale, and have put into verse sublime descriptions of it."

This more or less finishes the specific references made to the animals of India either by the Moghul Emperors themselves or by the better known contemporary travellers and chroniclers. Besides these accounts, miscellaneous notes were found sprinkled through the various works consulted, which are set forth below as they make interesting reading, but without any effort at arrangement, chronological or otherwise.

Hospitals for Birds and Animals

Pietro della Valle who visited India in the reign of the Emperor Jehangir describes [4] one of these *pinjrapoles* at Cambay thus :— " The house of this hospital is small, a little room sufficing for many birds of all sorts which need tendence, as cocks, hens, pigeons, peacocks, ducks and small birds, which during their being lame, or sick or mateless are kept here, but being recovered and in good plight, if they be wild are let go at liberty ; if domestic, they are given to some pious person who keeps them in his house. The most curious thing I saw in this place, were certain little mice, who being found orphans without sire or dame to tend them, were put into the hospital, and a venerable old man with a white beard, keeping them in a box amongst cotton, very diligently tended them with his spectacles on his nose, giving them milk to eat with a bird's feather, because they were so little that as yet they could eat nothing else ; and as he told us, he intended when they were grown up, to let them go free whither they pleased."

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[1] *Jeh.*, vol. ii, p. 292, *et seq.* [2] *Jeh.*, vol. ii, p. 146. [3] *Jeh.*, vol. i, p. 43.
[4] Beni Prasad, *History of Jehangir*, p. 290.

Mons. de Thevenot writing in the time of Aurangzebe of the city of Ahmedabad, states : " In this town there is an hospital for Birds. The gentiles lodge therein all the sick birds they find and feed them as long as they live if they be indisposed. Four-footed beasts have theirs also : I saw in it several oxen, camels, horses and other wounded beasts who were looked after and well fed, and which these idolators buy from Christians and Moors that they may deliver them (as they say) from the cruelty of infidels, and there they continue if they be incurable, but if they recover, they sell them to the gentiles and none else."

Decoying Game Birds by Sound

Jehangir describes a method of capturing some species of game bird (Sandgrouse?) as follows :—" While I remained in the precincts of Dehly, at the period to which I shall now return, they described to me a species of feathered game, with tails of a particular description, and the flesh of which was of a flavour in the highest degree delicious. But what more particularly attracted my curiosity, was that they spoke a language known to none but the natives of Kashmir, who by using a sort of note or call, took from them the power of flight ; and who were thus able to catch them by thousands at a time. On a plain in the neighbourhood frequented by thousands of these birds in a flock, by way of experiment I employed about a thousand Kashmerians, accustomed to the business, to give me a proof of their skill, and I attended in person to view the sport. As had been represented to me, about twenty of the Kashmirians collected together and produced a sort of murmuring sound, which attracting the attention of these birds, they were drawn by degrees within such a distance of the men, that they were taken in entire flocks. My pity was greatly moved by the reflection that these harmless birds should have fallen victims to this sort of treachery ; that they should have been betrayed into the hands of the destroyer by their irresistible love of harmonious sounds, and that I should be found capable of consigning them to slaughter from a mere idle and vicious curiosity ; the next day therefore I caused the whole, to the number of twenty thousand birds which had been taken on the occasion to be set at liberty. My object was attained in witnessing the fact. But to have seen them slaughtered would have bespoken of a want of compassion foreign to my nature."

It may be mentioned that the above passage is from a translation of the alleged *Memoirs of Jehangir*, from a Persian manuscript by Major David Price of the East India Company, A. D. 1829. From Appendix C to Beni Prasad's *History of Jehangir* however it now appears settled beyond doubt that Major Price's manuscript represents a forgery and that the *Tūzūk-e-Jehāngīri* as published by Syed Ahmed Khan and translated by Rodgers and Beveridge forms the real Memoirs.

"PERILS OF JOURNEYING IN THE INDIA OF THE SIXTEENTH CENTURY"

The Jesuit, Fr. Monserrate, who travelled from Goa to Akbar's Court at Fatehpur writes[1] in all earnestness: "Next Suiranges (Siron) was reached. The town suffers from a most unhealthy climate, as a consequence of which the cracks and dark corners of the houses are infested with all manner of poisonous vermin, which are found here in great quantities. At night also the beds are beset with scorpions whose sting brings on horrible agony. In the neighbouring marshes certain lizards are found (although indeed they are just as much at home in dry places as in marshes) whose bite is fatal. In bushes and thickets, the many coloured Regulus is found which kills by the glance of its eye. The little part of its body is red towards the head,—a more brilliant red even than scarlet—but elsewhere it is orange-coloured varying towards dark brown. It attracts the eyes of all who see it by reason of the beauty of its colouring. However, the mercy of God has decreed that its nature shall be such that if a man sees it first, the Regulus—like the wolf, if one may believe the common tale—is compelled to retreat precipitately to some hiding place where it conceals itself. But if some unfortunate man, who in ignorance of his danger is doing something else, is seen by the Regulus (which like other creatures of this class is very proud of its own beauty) some little time before he sees it, then he is bound to perish miserably, at least so the inhabitants of the region stoutly declare. One of the fathers unwittingly ran the risk of perishing in this way; for seeing the little creature, and being attracted by its beauty, he tried to catch it, and followed it till the Regulus hid itself in a thicket. When he returned to his quarters and asked the inhabitants of that place what sort of a lizard it was, that he had seen, they were no less surprised at his having escaped the glance of the Regulus than were the inhabitants of Malta at St. Paul remaining unharmed by the bite of the snake. This is roughly the size of a dormouse, and resembles the lizard called the 'chamæleon' which feeds on air and disguises itself with the colour of whatever object is nearest."

Comment on the above is needless.

WEIGHT CARRIED BY A CAMEL

Jehangir records that one of his "home-bred" camels that was with him in a hunt, carried five Nilgaus that weighed 42 Hindustani maunds. (Equal to 1459½ lbs.)

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[1] *The Commentary of Fr. Monserrate* translated by Hoyland and Banerji.

THE FRUITS AND FLOWERS OF HINDUSTAN

In the course of a very painstaking account of the fruits growing in the neighbourhood of Agra, Jehangir says " Of all fruits I am very fond of the mango." In regard to flowers, the Emperor writes as follows[1] " From the excellencies of its sweet-scented flowers one may prefer the fragrances of India to those of the flowers of the whole world. It has many such that nothing in the whole world can be compared to them. The first is the Chumpa (*Michelia champaca*) which is a flower of exceedingly sweet fragrance ; it has the shape of the saffron flower, but is yellow inclining to white. The tree is very symmetrical and large, full of branches and leaves, and is shady. When in flower, a tree will perfume a garden."

Praises of Keora flower (*Pandanus odoratissimus*), Rae bel (presumably some sort of Jessamine), Mulsari or Bholsari (*Mimusops elangi*), Chambeli (*Jasaminum grandiflorum*), etc., follow.

" Of the trees there are the Cypress (*Sarw*), the Pine (*Sanubār*), the Chanar (*Platanus orientalis*), the White Popular (*Safidar—Populus alba*) and the Bid Mulla (willow) which they had formerly never thought of in Hindustan, but are now plentiful. The Sandal tree which once was peculiar to the islands (i. e. Java, Sumatra, etc.) also flourishes in the gardens."

" FIGHTING OF BEASTS "

Mons. de Thevenot writes in the reign of Aurangzebe[2] as follows : " There are a great many at Agra, who are curious in breeding up of beasts, to have the pleasure to make them fight together : but seeing they cannot reach to elephants and lions because it costs dear to feed them, most part content themselves with He-goats, Weathers, Rams, Cocks, Quailes, Stags and Antilopes, to entertain their friends with the fighting of these beasts."

A METHOD OF CAPTURING WATERFOWL

Mons. de Thevenot describes a method, still largely in vogue, in the following words : " The Indians are very dextrous at Game, they take waterfowl with great facility as thus : The Fowlers swim almost upright, yet so that they have their Head above water, which they hide with a Pot full of holes, to let in the air, and give them sight ; besides this Pot is covered with feathers, to cheat the Ducks and other Fowls ; so that when the Fowler draws near them they are not in the least scared, taking that floating head for a Fowl ; and then the Fowler makes sure of them by their feet which he catches hold of under water and draws them down. The other ducks seeing nobody, think that their comrades have only dived, and are not at all scared ; so that growing acquainted with the feathered head, that still follows them they are at length all taken, whilst in vain they stay for the return of those who have dived, before they fly away to another place."

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[1] *Jeh.*, vol. i, p. 5.

[2] *Travels into the Levant*, part iii, p. 38.

" Of the Beasts at Dehly "

In a chapter thus entitled, the same traveller says: " At Dehly are all sorts of Beasts that are known. The King hath many and private men who are rich have also some. They have Hawks of all kinds; all kinds of Camels, Dromedaries, Mules, Asses and Elephants. They have also Elks and Rhinoceroses which are as big as the largest oxen. The ordinary oxen are less than ours. Buffles they have also, and those of Bengalla are the dearest because they are very stout and are not at all afraid of lions. Nor do they want dogs of all sorts, but those which are brought from Maurenahar (Māwarā-ūn-nahar) or Transoxiane, are most esteemed for Hunting, though they may be smaller; however, the Indian Dogs are better for the Hare; they also have Stags, Lions and Leopards."

The Zebra

Jehangir thus describes this animal[1] which it is not clear from the translation whether he received from or sent to the King of Persia as offering (*circa* A. D. 1621) " At this time I saw a wild ass (*Gor-khar*) exceedingly strange in appearance exactly like a tiger. From the tip of the nose to the end of the tail and from point of the ear to the top of the hoof black markings large or small, suitable to their position were seen on it. Round the eyes there was an exceedingly fine black line. One might say the painter of fate, with a strange brush, had left it on the page of the world. As it was strange, some people imagined it had been coloured. After minute enquiry into the truth, it became known that the lord of the world was the creator thereof. As it was a rarity it was included among the royal gifts sent to (or by ?) my brother Shah Abbas."

The traveller Bernier mentions that the presents sent to the Emperor Aurangzebe by the King of Ethiopia, while the chronicler was at court, included " a small species of mule whose skin I have seen; no tiger is so beautifully marked and no *alacha* of the Indies or striped silken stuff is more finely or variously streaked."

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[1] *Jeh.*, vol. iii, p. 201.

THE CEYLON PEARL FISHERIES

BY

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Pearls have always been prized for their rare beauty and value and a very considerable literature has gathered around this 'most soveraigne commoditie.' The pearl fisheries of Ceylon in particular have attracted the attention of writers in all ages, and administrators, scientists and poets alike have contributed to the literature of this fascinating subject. Pearl fisheries never fail to arouse considerable interest in Ceylon, mainly, I suspect, because they are such rare occurrences and also perhaps, because both the Government and the general public regard them as a source of revenue out of all proportion to their true value.

A pearl fishery is an event which cannot fail to strike the imagination in a variety of ways. The thought of a 'pearl town' of 20,000 to 40,000 inhabitants springing into being on one of the most desolate parts of the Ceylon coast; the sight of a fleet of hundreds of fishing boats, backed by the setting sun, sailing homewards with its precious cargo; the excitement of the auction and the babel caused by a dozen different languages being spoken at the same time; and above all, amidst the excitement and bustle of this mushroom town an effective administration with its efficient police, medical and sanitary services.

All these things have been described a score of times and it is not my intention to traverse the ground made familiar by many writers. Instead I propose to discuss some aspects of the economic problems which have been the object of researches by marine biologists during the last quarter of a century.

The natural home of the Ceylon pearl oyster is in five to ten fathoms of water on the rocky stretches to be found on the narrow submerged shelf between the shore and the hundred fathom 'overfalls' in the Gulf of Mannar. These patches of rock or 'paars' are irregular and somewhat inconstant in shape and are broken up by stretches of sand which often invades the paars. In addition the paars are surrounded by vast sandy areas. Rock is the natural habitat of the pearl oyster and the presence of sand is decidedly inimical.

The outstanding features of the Ceylon pearl fisheries are their irregularity and uncertainty. Though they possess great potential value the fisheries are intermittent and since the pearl fishery of

1891 there have been only six fisheries in thirty-six years.[1] At the beginning of the present century the Ceylon Government sought the expert advice of a distinguished marine biologist, the late Sir William Herdman, F.R.S. Professor Herdman visited Ceylon in 1902 and with that visit began a period of intensive inquiry into the bionomics of the pearl oyster which was continued by Messrs. Hornell and Southwell, and later by the present writer.

In the present paper it is proposed to deal only with the paramount problem of the intermittent fisheries. Two questions may be asked:—

(1) Why are the Ceylon pearl fisheries intermittent?
(2) Is it possible to ensure annual fisheries?

These two questions have been fully investigated in the last quarter of a century and the irregularity of the Ceylon fisheries has been ascribed to the rigorous conditions under which the Ceylon pearl oyster is said to live. Apart from the menace of disease there are two chief dangers to which the pearl oyster is exposed.

(1) *Predacious fishes* which eat the oysters and which have been known to exterminate large beds.

(2) *Sand* which encroaches upon the oyster beds resulting in their extermination.

In addition to these two chief dangers there is also the alleged danger of overfishing.

PREDACIOUS FISHES

There is no doubt that fish enemies, particularly the large rays which frequent the pearl banks in shoals, play an important part in the economy of the pearl oyster. Mr. Hornell attached special importance to this danger and went so far as to affirm that this was the 'key to the problem' of irregular fisheries. He believed the fish enemies to be the 'dominant factor in the economy of the Indian and Ceylon pearl fisheries.' He stated that the increase in predacious fishes synchronized with the rehabilitation of the pearl banks, and that the fish population eventually became so great as to disturb the balance of Nature thus bringing about the extermination of the oysters. This view does not appear to have been based upon actual experimental evidence and may be regarded as an expression of opinion and nothing more. To have obtained evidence on this point would have entailed intensive trawling operations on a scale which has not been possible before, during or since Mr. Hornell's time. One would naturally assume, however, that the fish density on the pearl banks would vary directly as the abundance of oysters and there can be no doubt that in specific cases beds of oysters have been destroyed by the action of shoals of rays. If, however, the problem of the intermittent pearl fisheries depended upon nothing more than the delicate adjustment of the balance between the degree of predacioussness of the fishes on the one hand and the measure of fecundity of the oysters on the other, as Mr. Hornell suggests, we should expect to find a similiar state of precariousness and irregularity in pearl fisheries elsewhere. As far as can be ascertained, however, this is not the case. In the Persian Gulf, for instance, annual fisheries are the rule, and there is no reason to believe that the ravages of the rays are less pronounced in the Persian Gulf than in the Gulf of Mannar.

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[1] There were thirty-three fisheries in the nineteenth century.

Mr. Hornell's claim is not very convincing, though everyone who has a working acquaintance with the pearl fishery problems will admit the seriousness of the fish menace. The obvious remedy is a campaign of intensive trawling operations, but the cost would be out of all proportion to the value of the pearl fisheries and it is by no means certain that the destruction of oysters by the heavy otter boards and nets would not be greater than that caused by the fishes themselves.

SAND

Professor Herdman expressed the opinion that shifting sand was 'the most important agent in causing widespread death of pearl oysters.' Mr. Southwell did not concur in this opinion, but my own views incline to those of Professor Herdman though I am not prepared to say that sand is more harmful than predatory fishes. There is every reason to believe that a large bed of oysters was lost in 1925 owing to the action of the sand.

Sand may be either a passive or an active danger. The mere presence of sand in the vicinity of the pearl banks is in itself detrimental as spatfalls take place equally on sand and on rock. Oysters will not thrive on sand and we may define this as a *passive* danger. Sand becomes an *active* danger when, owing to the movements of water, the sand is caught up in suspension and slowly deposited upon beds of oysters, or, as, Professor Herdman believed, is 'shifted' bodily in large masses through the powerful action of currents. There would appear to be no corrective for this active danger of silting or shifting sand, which doubtless has been responsible for the loss of many beds of oysters in the past.

In the case of a spatfall being deposited on sand (passive danger) two remedies have been suggested by Messrs. Herdman and Hornell. The first is 'cultching.' This term has been applied to the process of laying down on the floor of the sea a mixture of rock fragments, tiles, rubble, dead coral and other substances, collectively known as 'cultch', which will afford solid attachment for young oysters in places where there is an absence of rock. This process has been used for many years at Arcachon in France where the edible oyster is cultivated in shallow backwaters of the sea which are laid bare twice a day by the ebbing tide. White-washed tiles are laid down to which the young oysters attach themselves, and in this way the oysters can be farmed, cultivated and controlled as easily as a field of grain. But it would be a very difficult proposition to adapt this method to the Ceylon pearl banks where the oysters lie in comparatively deep water in the open sea. A spatfall frequently occurs over many square miles of sand and it is calculated that 10,000 to 15,000 tons of cultch would be required to cover one square mile of sea bottom. There is no guarantee that this method would provide even a temporary relief and it is quite certain that the cultch would become covered over by sand in course of time. The process is obviously impracticable on economic grounds. It is interesting to note that cultching was begun on the Ceylon pearl banks but later was discontinued, very properly as I believe, on the advice of Mr. Southwell.

It was further suggested that transplantation should be resorted to in cases where large deposits of spat occurred on sand. In theory this would be useful, not only when a spatfall took place on unsuitable ground but also when oysters on good ground were over-crowded. I believe that transplanting has much to commend it, but like so many expedients relative to the Ceylon pearl fishery the cost would far outweigh its probable utility. Mr. Hornell, who was a keen advocate of transplanting operations, has now changed his opinion and has stated that 'with riper experience I 'have come to the conclusion that the heavy expenditure these 'means necessitate are not justifiable from a financial standpoint.'

Overfishing

From 1907 to 1925 there were no fisheries on the Ceylon pearl banks.[1] The pearl banks were leased to a public company in 1905 and the supply of oysters failed two years later. The general impression in Ceylon was that the pearl banks had been overfished by the company. This ignorance of the true state of affairs was widespread and so recently as 1925 a statement was made in the Ceylon Legislative Council that 'the company paid no 'attention whatever to the pearl banks. They tried to get as much 'as possible out of them and scraped the spat.' This recalls the charge which was made against the administration of Sir Robert Wilmot Horton in the thirties of last century of having 'caused the pearl banks to be overfished, scraped and ruined.' There was no justification for this opinion and it is most unlikely that overfishing has ever been practised on the pearl banks. Under the present system of diving, which has remained unchanged for many hundreds of years, it would be difficult to overfish even if one were so inclined. The late Sir William Twynam, K.C.M.G., who had an unrivalled knowledge of the Ceylon pearl fisheries based upon thirty-five years' experience, wrote as follows in 1899: 'I do not 'concur in the least with those who cry out that the banks are or 'have been overfished and consequently that no oysters have been 'left to breed and replenish the banks. The divers do not and 'cannot clear away all the oysters on a bank at a fishery.' It is safe to assume that the divers leave at least five per cent of the oysters. Far from overfishing being a danger it is much more likely that many a fine bed of oysters has perished undiscovered and unfished owing to the old surveys being inaccurate on account of the inadequacy of the land marks. The sudden disappearance of oysters after the 1907 fishery was certainly not due to overfishing. Capt. Kerkham, Superintendent of Fisheries, informed me that he discovered a compact bed of oysters in 1908, but the season was too far gone to arrange a fishery and when the next inspection was made it was found that the oysters had died of old age.

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[1] This is not a record as some people think. A similar gap occurred from 1837 to 1855.

Both Professor Herdman and Mr. Southwell believed overfishing to be a danger though the former made no recommendations to meet it. Mr. Southwell expressed the opinion that the denudation of the banks was due to overfishing and to the attacks of predatory fishes. As a remedy he proposed to establish breeding reserves and he advocated the protection of young oysters by laying down sheets of wire netting over the oysters. The provision of breeding reserves can be justified only if overfishing is feared, but enough has been said already to show that such fears are groundless. Consequently, I do not believe that breeding reserves are necessary.

To sum up briefly what has been said in the preceding pages. The peculiarly intermittent nature of the Ceylon pearl fisheries has been attributed to a variety of causes chief amongst which are the effects of predacious fishes, the action of sand and overfishing. I cannot believe that these agencies, either individually or collectively, are responsible for the unfortunate state of affairs though they may be, and doubtless are, a contributory cause. To counteract the harmful effects of predatory fishes recourse must be had either to intensive trawling or to Mr. Southwell's proposed wire-netting protection; to meet the harmful action of sand both cultching and transplanting have been suggested. All these proposals are correct enough in theory but they would prove impracticable if applied to the Ceylon pearl banks, and they can be dismissed once and for all from an inquiry which is searching for practical and economic remedies. As I hold that the charge of overfishing cannot be maintained the recommendations about breeding reserves may be dismissed. If the views stated above are correct the united efforts of the workers of the first two decades of this century failed both in indicating the true cause of the many unprofitable periods which characterize the Ceylon pearl banks and in suggesting a remedy. It cannot be said that a very convincing case has been made out to show that fishes and sand have any *vital* relation to the main problem and I would go even so far as to say that if all predatory fishes were cleared from the pearl banks and if sand and other inimical factors were eliminated we should still retain this unfortunate heritage of irregular fisheries.

I regard the true cause of these irregular fisheries as a geogrphical one. The Ceylon pearl banks are situated on a narrow shelf between the deep 'overfalls' and the shallow inshore waters. The Cheval Paar, for instance, covers an area of about 25 square miles of rock surrounded by hundreds of square miles of sand. This paar is only five miles from the shore on its eastern boundary and a similar distance from the 100 fathom line on its western border, narrow enough confines for the habitat of an organism which spends the first few days of its life floating in the surface water and which can only establish itself successfully on rock in depths of five to ten fathoms. The pearl oyster becomes sexually mature at the age of twelve months and thereafter has two sexual periods in each year, but there is no guarantee that a bed of oysters, once established, will produce a spatfall within the circumscribed limits of the pearl banks. The floating larvæ are at the mercy of the elements and no human effort can influence or control the course which these larvæ may follow in the few days of their pelagic life. An abnormal monsoon, a change in the current, or any one of a hundred other factors might be sufficient to prevent the young oysters from being deposited on the rocky paars of the pearl banks. They might be carried out into the deep water beyond the overfalls where, even if they did not perish, they would be beyond the reach of the divers; or, on the other hand, their course might be directed shoreward in which case they would come to grief in the coastal shallows.

The expedients which have been discussed in the early part of this paper had reference mainly to the care and protection of oysters which had already established themselves in the paars, but such remedies would avail nothing if the progeny of these oysters, born in uncountable millions twice a year, ultimately found themselves deposited on unfavourable ground where they would be doomed to early destruction. The fate of the spatfall, therefore, is one of momentous importance. If the Ceylon pearl banks consisted of a wide stretch of paar ground it would be reasonable to expect annual fisheries, but as things are—a narrow shelf of rock 'between the devil and the deep sea,' and pelagic larvæ whose migrations cannot be directed or controlled—it would appear to be beyond the wit of man to devise a remedy.

It is ironical that so simple an explanation offers no solution, but it is clear that the nearer this explanation approaches the true one the more unsatisfactory would the proposals discussed in this paper appear to be. My predecessors clearly held the view that the Ceylon pearl banks had a bright future before them. Even in the dark days of 1911 when the pearl banks were barren and the Ceylon Company of Pearl Fishers ceased to function Mr. Southwell, believing that a spatfall was imminent ventured the opinion that, given a spatfall 'only thorough inspection, care and normal fore-'sight in isolating breeding stocks, etc., are required to make the 'banks perennially productive.' Mr. Southwell was engaged in scientific work with the company in 1907 when their last fishery took place. From what I know of Mr. Southwell's work I feel sure that all the conditions laid down in the above quotation were faithfully carried out by him. It is certain that a large natural breeding reserve was left after the 1907 fishery, as Capt. Kerkham discovered a compact bed of oysters in 1908. Why then, have the pearl banks not been 'perennially productive' since 1907? The explanation would appear to be that the last spatfalls were not deposited in adequate numbers on the pearl banks but fell on unfavourable ground.

The present condition of the pearl banks confirms in a striking manner what has been said about the importance of the spatfall. From 1919 to 1923 there were successive spatfalls and in 1924 there were some thousands of millions of oysters of various ages on the banks, but since the end of 1923 there has not been a single spatfall of any magnitude although there were enormous numbers of oysters on the banks. It may be anticipated, therefore, that the present series of oysters which first made their appearance on the banks in 1919 will die out in 1929 if no further spatfall takes place, as there has not been a successful spatfall since 1923. It may be said, incidentally, that although there are large numbers of oysters scattered over the banks at present, forming an excellent breeding reserve, they do not occur in sufficient numbers and in sufficient density to justify a fishery. Under present conditions if all harmful agencies such as fishes and sand were removed the banks would become barren about 1829 unless we are fortunate enough to have a spatfall in the next year or so.

It would appear, therefore, that the intermittent fisheries will continue to characterize the Ceylon pearl banks, and the banks will never become 'perennially productive' because we cannot control the course of ocean currents or direct the destiny of the floating oyster larvæ by the application of scientific principles. To quote the words written nearly a century ago by a former Inspector of the Ceylon pearl banks, 'Unsuccessful intervals will continue 'to recur . . . . . we cannot cause the spawn to settle down upon 'nourishing ground. These are events beyond the control of man. 'The winds, the waves, and the uncertain currents of the ocean 'carry the embryo over unlimited space. It is only when in the 'infinite wisdom of the Creator of all things, the oyster brood 'descends upon the banks . . . . . that it comes within our limited 'power . . . . . . to fish up the respective deposits as they approach 'the proper age.' In my opinion the case could not be summed up better than that.

I have confined my remarks to what may be regarded as the fundamental problems, which concern the economic prosperity of the Ceylon pearl banks, and in so doing I have been forced to ignore much of the valuable work of my predecessors. It is a thankless task to offer criticisms of other people's work and it would have been much more congenial to have had the opportunity of bearing testimony to the valuable advances in marine biology which we own to Herdman, Hornell and Southwell. With regard to the application of marine biological science to the economic problems of the Ceylon pearl fisheries it must be confessed that, whatever may be the cause of the peculiar uncertainty of the pearl fisheries, we have all failed to find a remedy. In the opinion of my predecessors the remedy is in man's hands; in my opinion there is no solution. It is not an easy matter to have to confess that marine biology can offer no solution of this most interesting problem but my own examination of the matter, extending over more than fifteen years, does not permit me to come to any other conclusion with the evidence at hand.

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART IV

GRAMINEÆ

BY

E. BLATTER and C. McCANN

(Continued from page 33 of this volume)

21. IMPERATA, Cyr.

Species 5 or 6, nearly allied. In the warm regions of both hemispheres.

Imperata cylindriaca, Beauv. Agrost. 165, t. v, fig. 1, Explan. planch. 5 ; Cyr. Pl. Rar. Neap. Fasc. ii, 26, t. ii ; Hack. Monogr. Androp. 92 ; Boiss. Fl. Or. v, 452 ; Duthie Grass. N. W. Ind. 14 ; Indig. Fodd. Grass t. 15 ; Fodd Grass. N. Ind. 22 ; F. B. I. vii, 106 ; Cke. ii, 946 ; Haines Bot. Bihar and Orissa, pt. v, 1015 ; Stapf in Fl. Trop. Afr., ix, 87.—*I. Koenigii*, Beauv. Agrost. 165.—*Saccharum cylindricum*, Lam. Encycl. i, 594 ; Roxb. Fl. Ind. i, 234 ; Grah. Cat. Bomb. Pl. 239 ; Griff. Notul. iii, 80.—*S. europaeum et S. indum*, Pers. Syn. i, 103.—*S. Ravennæ*, Bieb. Fl. Taur. Cauc. iii, 51.

Some authors distinguish varieties and subvarieties which scarcely seem to be justified. Stapf who mentions two varieties (var. *Thunbergii*, Durand & Schinz, and var. *Koenigii*, Durand & Schinz) says in a note (l. c. 89) : 'The varieties and the type, although on the whole pretty distinct within their areas, often pass into each other, chiefly along the confines of their areas, or they possibly lose their distinctive characters under particular local conditions, when the separation becomes almost impossible.' This does not speak in favour or good varieties. Hackel (l. c. 93-95) has 3 varieties and several subvarieties, and Anderson (in Oefvers. K. Vet. Akad. Forh. Stockh. 1885, p. 157) is still more liberal with his subvarieties. Hook, f. makes one variety *latifolia* (F. B. I. l. c.) and remarks about one of Hackel's varieties : 'Hackel distinguishes the Indian form as var. *Koenigii* having villous nodes and broader, less rigid leaves, but some of the Indian specimens appear to me quite like the Western Hackel's division depends chiefly on such characters as hairiness of the leaf-insertions, width of the leaves and height of the ligule. The height and shape of the ligule, however, seems, according to Hole's investigations, more or less correlated with the width of the lamina, while the other characters appear to vary with the locality and do not define forms of any constancy. Hole's treatment of *Imperata arundinacea* (On Some Indian For. Grasses and their Oecology, 1911, p. 95) appeals to us much more. Amongst the material observed at Dehra Dun he distinguishes 3 forms which are more or less clearly defined :—

(*a*) The depauperate form common on lawns or areas where the grass is continually cut or grazed, with minute, almost filiform, culms and small leaves. Leaf-insertions usually long-bearded. Glume IV and pale usually glabrous.

(*b*) The ordinary savannah form which usually attains a height of about 90 cm. with leaves up to 17 mm. wide. Leaf-insertions bearded or glabrous. Pale and glume IV ciliate.

(*c*) A robust form found in swamps or marshy soil where there is an abundance of available moisture more or less throughout the year. This plant attains a height of 2·8 m. and probably more. Leaves up to 26 mm. wide, leaf-insertions glabrous. Pale and glume IV ciliate. This is identical with var. *latifolia*, Hook. f.

Forms of this kind could be multiplied according to various localities. As we are not going to distinguish any varieties we give a description of the species including all the variations that so far have been observed.

Description :—Culms erect, simple, slender, from 12 cm. in height and almost filiform to 2·8 m. high and 8 mm. diam., 3–4–noded, glabrous, solid, slightly fistular at base : leaf-insertions tumid, glabrous or densely bearded with erect white hairs. Leaf-sheaths rather loose, glabrous or glabrescent, ciliate or glabrous along the margin towards apex, the lowest at length usually breaking up into fibres, usually longer than proper internode ; ligules membranous, rounded, truncate or 2-lobed, ciliate, dorsally silky, attaining a height of 3 mm. Blade of uppermost leaf of flowering culm from mucroniform and 1·25 mm. long to 15 cm. long and 6 mm. wide with greatest width in middle, of lower leaves erect or arcuate and attaining a length of 1·2 m. and width of 27 mm., greatest width about the middle, dark green, midrib white, apex acuminate, narrowed towards the base where the midrib occupies almost the entire width of the leaf, smooth, but scabrid on margin and on one or more sub-marginal nerves above, especially towards the apex, white villous above on margins towards the base and behind the ligule. Panicle spike-like, 3-50 cm. long, not exceeding 25 mm. in width, cylindric, very dense ; branches and branchlets very numerous, crowded, appressed ; pedicels fine with clavate tips, glabrous, scaberulous or pubescent, with long fine hairs below. Flowering panicle purple with the exserted stigmas, the callus-hairs being closely appressed to the axis, fruiting panicle silvery white with the wide-spreading callus-hairs. Spikelets not awned, lanceolate, 3 mm. long, both spikelets of each pair similar, each 1-flowered and hermaphrodite, and at length falling from the pedicel ; callus-hairs soft, white, 2–3 times as long as the spikelets. Lower involucral glume lanceolate, membranous, slightly thickened towards the base, apex hyaline, 3–9-nerved, none of the nerves extending to apex of glume, margins incurved, ciliate above, dorsally villous with soft white hairs overtopping the glume by $1\frac{1}{2}$ to 3 times the length of the glume. Upper involucral glume similar and subequal to the lower, but sometimes sub-keeled with mid-nerve extending almost to apex. Lower floral glume oblong, hyaline, nerveless, apex acute or subtruncate and laciniate or denticulate, ciliate, $\frac{1}{2}$ to $\frac{3}{4}$ of the upper involucral glume. Upper floral glume subequal to the lower one, ovate-lanceolate, hyaline, nerveless, apex acuminate, acute or obtuse and laciniate or denticulate, minutely ciliate or glabrous. Pale quadrate, rectangular or subpentagonal, hyaline, nerveless, apex denticulate or unequally laciniate, glabrous or ciliate, $\frac{1}{2}$ the size of the upper floral glume or subequal to it. Lodicules none or very minute. Anthers 2, 2·5–3 mm. long, orange, filaments sometimes connate below. Stigmas 2, 3–4 mm. long, purple.

Locality : Sind : (Stocks).—*Gujarat :* (Graham).—*Konkan :* Tardeo, Bombay (Hallberg 5398 !) ; Alibag, sandy shore (Ezekiel !) ; near Thana (McCann !); Banks along railway track between Ghatkoper and Thana, Salsette (McCann !).—*S. M. Country :* Shiggaon (Sedgwick 2353 !); Dwararji (Sedgwick and Bell !); Castle Rock (Bhide !) ; Londa, common (McCann !).—*Kanara ;* Halyal (Talbot 1896 !).

Distribution : The hotter parts of India, ascending in the Himalayas to at least 6,500 feet, Mediterranean region ,Africa, Java, Japan, China, Australia.

Biology and Ecology : See Hole, l. c. 96.

Uses : Duthie says of this grass that ' cattle relish it '. ' In Australia,' he says, ' it is called blady grass and the young succulent foliage which springs up after the occurrence of a fire is much relished by stock. I have observed the same effect resulting from periodical fires on certain parts of the Himalaya where this grass is plentiful.' (Duthie, Fodd. Grass. of N. Ind. 23). ' In India,' according to Hole (l. c. 101) ' the succulent white stolons are eaten by pigs and areas which have been well-worked by pigs in their search for the stolons are not infrequently seen in the forest. It is possible that in some cases the eradication of the species might be cheaply accomplished by the aid of pigs.'

This grass is also known as a paper-making material : ' The ultimate fibre obtained from this grass is very similar in most respects to Esparto ; the yield of bleached fibre being about the same. This is a favourable indication inasmuch as Esparto is one of the best known and most useful sources of supply to the trade. The results obtained from the chemical analysis show that the grass is capable of yielding a good quality of cellulose, suitable in every way for the manufacture of paper.'[1]

The leaves are largely used for thatching (Hole).

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[1] *Agric. Bull. of the Straits and F. M. States*, vii (1908), 586.

22. Saccharum, Linn., Stapf Fl. Trop. Afr. ix, 94

The genus as understood by the latest agrostologists comprises also the species which were formerly described under the genus *Erianthus*, Michx. As already remarked by Haines in his Flora of Chota Nagpur the awned upper floral glume of some *Saccharum* breaks down the only distinction between *Saccharum* and *Erianthus*.

Cooke (ii, 948) mentions 3 species of *Saccharum*: *T. spontaneum*, Linn., *S. arundinaceum*, Retz. and *S. officinarum*, Linn. To these we add *S. Munja*, Roxb. and *S. Griffithi*, Munro. The two species of *Erianthus*, observed in the Presidency, viz. *E. Ravennæ*, Beauv. and *E. fastigiatus*, Nees, will be transferred to *Saccharum.*

General characters of *Saccharum*: Perennial tall herbs. Leaves various. Panicle large, often silvery-silky and showy, spikelets usually surrounded by long silky hairs from the base, all alike, binate, one sessile, the other pedicelled on the articulate fragile rhachis of panicled racemes, the pedicelled falling from their pedicels, the sessile deciduous together with the contiguous joint of the rhachis and pedicel. Florets 2, the lower reduced to an empty valve, the upper hermaphrodite. Involucral glumes equal, often chartaceous to subcoriaceous towards the base, membranous to subhyaline upwards; the lower glume with inflexed margins and in the sessile spikelet usually with an even number of nerves; upper glume 1-, 3-, or 5-nerved. Floral glumes hyaline; upper with a terminal bristle-like usually straight awn, or mucronate, or muticous, or 0. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong to subglobose; embryo short to half the length of the grain or more; hilum basal.

Key to the species, mainly after Haines.

A. Awn of upper floral glume not or scarcely exserted from spikelets or 0.
  I. Hairs on callus of sessile spikelet much exceeding the spikelets
    1. Culms not leafy above, under 17 mm. diam. Leaves under 20 mm. broad. Lower Involucral glumes ciliate ... ... 1. *S. spontaneum.*
    2. Culms densely leafy above, over 25 mm. diam. Leaves over 25 mm. broad. Lower Involucral glumes glabrous ... 2. *S. officinarum.*
  II. Hairs on callus of sessile spikelet shorter or not much longer than spikelet
    1. Upper involucral glume of sessile spikelet not villous dorsally
      (*a*) Foliage not glaucous. Culms densely leafy above. Sessile spikelet shorter than internodes of rhachis ... ... 3. *S. arundinaceum.*
      (*b*) Foliage glaucous. Culms not leafy above Sessile spikelet longer than internodes of rhachis ... ... 4. *S. munja.*
    2. Upper involucral glume of sessile spikelet villous dorsally ... ... 5. *S. Griffithii.*
B. Awn of upper floral glume distinctly exserted from the spikelet
  I. Panicles thyrsiform. Spikelets 3–4 mm. long. Awn 2·5 to almost 6 mm. long ... ... 6. *S. Ravennæ.*
  II. Panicles not thyrsiform. Spikelets 4 to almost 5 mm. long. Awn 8 mm. long ... 7. *S. fastigiatum.*

In the following treatment of the various species we shall draw largely on R. S. Hole, On some Indian Forest Grasses and their Oecology, in *Indian Forest. Memoirs*, vol. i, pt. 1 (1911), 50–91.

1. **Saccharum spontaneum**, Linn. Mant. (1771), 183; Roxb. Fl. Ind. i (1832), 235; Griff. Ic. Pl. As. t. 139, f. 63; Dalz. and Gibs. 304; Duthie Grass. N. W. Ind. 15, Indig. Fodd. Grass. 57, Fodd. Grass. N. India, 25; Hack. Monogr. Androp. 113; Hook. f. F. B. I. vii, 119; Cke. ii, 948; Hole in Ind. For. Mem. i, pt. 1, (1911), 50; Haines Bot. Bihar and Orissa (1924), 1011.—*S. semidecumbens*, Roxb. l. c. 236.—*S. canaliculatum*, Roxb. l. c. 246.—*S. chinense*, Nees in Hook. et Arn. Beechy's Voy. 241.—*S. ægyptiacum* var. *sinense*, Anders. in Oefvers. K. Vet. Akad. Förhand. Stockh. (1855), 157 (*non S. sinense*, Roxb.).—*S. spontaneum*, Linn. subsp. *ægyptiacum* var. *nepalense*, Hackel, l. c. 116,—Rheede Hort. Malab. xii, t. 46 (probably).

We have not included the synonyms which Stapf Fl. Trop. Afr. ix, 95, has given under *S. spontaneum* var. *ægyptiacum,* Hack., as we are not in a position to judge whether it is a good variety or not. According to Hole the African forms placed under var. *ægyptiacum* differ from the Indian plants chiefly by their slightly larger spikelets. But he finds that this difference is very slight and that it fails in the case of some African specimens. 'Considering the great variability of the species in India it seems possible that a more complete knowledge of the African plant will prove *ægyptiacum* to be merely one of the several oecological forms which are defined by inconstant characters and which are connected by numerous intermediates.'

Description :—Stem erect or decumbent at the base, reaching up to 6 m. in height and 15 mm. in diam., solid above, fistular below, terete, indistinctly striate, usually pruinose when young, polished when old, silky below the panicle and minutely silky below the upper leaf-insertions, glabrous or minutely pubescent below the lower leaf-insertions. Leaf-sheath longer than proper internode, often with reddish or purplish blotches, villous at mouth, often minutely pubescent at base, otherwise glabrous or with scattered appressed hairs, sulcate. Blade erect, of uppermost leaf of flowering culm usually long, varying from 5 cm. to 90 cm. in length, of lower leaves up to 1·2 m. and even 2 m., usually very narrow, often not exceeding 1·5 mm. in width and then consisting of a very narrowly margined cancavo-convex midrib, but also attaining a width of 16 mm. glaucous, midrib white, margin scabrid, often villous above at base immediately behind the ligule. Ligule ovate or deltoid, base often sub-auricled, membranous, subacute or subtruncate, often fimbriate when old, up to 6 mm. high, minutely silky dorsally and ciliate. Flowering panicle 15–60 cm. long, conical or lanceolate to oblong, branches horizontally spreading or slightly ascending, usually reddish or purplish, with the callus hairs closely appressed to the branches of the panicle ; primary rhachis sulcate, silky with long white hairs ; primary branches subverticillate, simple or compound. Spikelets in pairs, one pedicelled and one sessile on the capillary jointed branches and branchlets, awnless, lanceolate, 2–5 mm. long, sessile and pedicelled similar, each one-flowered and hermaphrodite, pedicelled fruiting spikelet falling from the pedicel, the sessile spikelet falling later with the attached pedicel and joint of axis ; joint of axis longer or shorter than sessile spikelet, villous on margins, or on margins and dorsally ; pedicel ¼–1¼ the length of the sessile spikelet, but usually shorter than spikelet, glabrous or ciliate, shorter than proper joint ; callus-hairs white, from 1½–7 times as long as sessile spikelet. Lower involucral glume lanceolate, the basal third thickened, becoming hard and polished in fruit and more or less brown in colour, the upper two-thirds membranous hyaline, with 2 lateral nerves from which the margin is inflexed ; apex entire or minutely bidentate ; margin ciliate ; dorsally with the upper two-thirds minutely appressed-pubescent. Upper involucral glume broad-lanceolate, similar to the lower, but subkeeled with one central nerve ; apex sometimes mucronate ; margin inflexed and long—ciliate. Lower floral glume hyaline, nerveless, shorter than upper involucral glume, ovate-lanceolate, long—ciliate, minutely pubescent above dorsally. Upper floral glume minute, linear, ciliate, hyaline, sometimes 0. Pale minute, ovate, ciliate, often shorter than the lodicules. Lodicules 2, cuneate, glabrous or ciliate at apex. Anthers 3, yellow, turning brown. Stigmas 2, purple.

'The horizontally spreading callus-hairs of the fruiting spikelet form an efficient parachute which aids its distribution by wind. The hairs of neighbouring spikelets becoming entangled together, characteristic flocculent masses of several spikelets are often seen being carried by the wind or hanging on the adjacent vegetation.' (Hole).

As good field characters we may mention the narrow leaves and slender culms, the long callus-hairs and the brown coriaceous base of the involucral glumes.

This is a very variable species, and Hole does not think that we are justified in making different sub-species or varieties. He distinguishes 3 ecological forms :

(*a*) The dry sandy soil-form, a xerophilous type. The culms are slender, erect and tufted, usually less than 5 mm. diam. The leaves exceedingly narrow, sometimes only a little more than 1 mm. wide. The callus-hairs not less than 3½ times the length of the spikelet.

(*b*) The swamp form, a hygrophilous type, found in marshes and swamps with an abundance of available moisture more or less throughout the year. The culms are stout, 5–15 mm. diam., usually decumbent at base and not tufted. Leaves broad, reaching a width of 17 mm.

The callus-hairs 1½–3½ times as long as the spikelets. The fruiting panicle elongate-elliptic to oblong with its branches usually more persistent than in other forms.

(*c*) The loam-form, intermediate between (*a*) and (*b*). The culms are more or less decumbent at the base and not tufted, but less robust and with longer callus-hairs than in (*b*).

Locality: Sind: Shikarpur (Woodrow) ; Mirpur Sakro (Blatter and McCann D697 !).—*Gujarat :* Baroda (Cooke) ; Domas near Surat (Dalzell and Gibson). —***Khandesh*** *:* Dadgaum (McCann 9892 !) ; Northern slope of Chanseli (McCann 9893 !); Bor, Bori River (Blatter and Hallberg 4422 !);—*Konkan :* Kamana, Mahim (Ryan 2205 !); Sakwar, river side (Ryan ? 2080 !); Bassein (Ryan 4 !); Karjat (Woodrow), on river bank (McCann !); Vihar Lake (McCann 9,894 !); Alibag, sandy shore (Ezekiel !).—*Deccan :* Igatpuri, on banks of bund (McCann 4334 !); Poona, river bank (Woodrow).—*S. M. Country :* Banks of streams, common in the S. Dharwar District (Sedgwick and Bell 3693 !); Haveri (Talbot 2236 !); Castle Rock (Gammie 15743 !, McCann !); Belgaum (Ritchie).–*Kanara :* Suppa, bed of Kala Nuddi (Talbot 2196 !) ; Hullikal (Talbot 1348 !).

Distribution of the species, irrespective of the varieties : Africa (Upper Guinea, Nile Land, Mozambique District), Lower Egypt, Arabia, Syria, Afghanistan, India, Ceylon, Burma, China, Java, Philippines, New Guinea, Australia.

Uses : A favourite fodder of buffaloes. The leaves are used for thatching and brooms. Valuable as a fixing agent for shifting sand and unstable soil. For *S. spontaneum* as a potential source of paper plup see W. H. Brown and A. F. Fischer. Philippine forest products as sources of paper pulp, in Forest. Bur. Philipp. Islds. Bull. 16 (1918).

* 2. **Saccharum officinarum**, Linn. Sp. Pl. ed 1, 54 ; Roxb. Fl. Ind., i, 237 ; Beauv. Agrost. Explan. planch. 5, t. iv, fig. 10 ; Hack. Monogr. Androp. 111 ; Hook. f. in F. B. I. vii, 118 ; Cke. ii, 948 ; Haines Bot. Bihar and Orissa 1012 ; Stapf Fl. Trop. Afr. ix, 96.

Description : Stems up to 6 m. high, many-noded, glabrous or pubscent below the panicle, more or less coated with wax below the nodes. Leaf-sheaths tight, terete, smooth, glabrous except when young ; ligules very short, membranous, ciliate ; blades linear-lanceolate, up to 1·5 m. long and over 5 cm. broad green above, glaucous below, more or less scabrid along the margins, midrib very stout, rounded on the back, more or less flat above. Panicles pyramidal, up to 1 m. long, dense, silvery ; primary rhachis glabrous except on the pubescent nodes, or more or less silky ; primary branches verticillate or semiverticillate, very slender, glabrous or hairy. Racemes up to 10 cm. long, very fragile ; joints and pedicels filiform, more or less ciliate or glabrous, the joints variable in length, the pedicels much shorter. Spikelets lanceolate, up to 4·2 mm. long, surrounded from the callus by a tuft of long silky hairs up to 9 mm. long. Involucral glumes subequal, lanceolate, firm towards the base, otherwise subhyaline the lower acute, 2-nerved to sub-4-nerved, glabrous, the upper very similar, 1-3-nerved, glabrous or ciliolate. Lower floral glume oblong, acute or subacute, hyaline, nerveless, ciliate, about 3·3 mm. long, upper floral glume subacute, ciliate, as long as the lower or 0. Pale, if present, very minute, obovate, ciliate. Lodicules broad, cuneate, sparingly ciliolate from the top. Stigmas purplish. 2·1 mm. long. Grain oblong, attenuated upwards, subterete, flesh-coloured ; embryo ⅙ the length of the grain.

Locality : Grown throughout the Presidency.

Origin :—There are many indications that S. Asia is the original home of the sugarcane.

* 3. **Saccharum arundinaceum,** Retz. Obs. bot. fasc. IV (1786), 14 ; Hackel Monogr. Androp. 117, excl. syn. *S. exaltatum* ; Hook. f. in F. B. I., vii. 119 excl. syn. *S. ciliare*, Anders., *S. exaltatum*, Roxb., *S. munja*, Roxb., *S. Sara* Roxb.; Cke ii, 948, excl. syn. *S. exaltatum*, Roxb.; Haines Bot. Bihar and Orissa, 1012. *S. bengalense*, Retz. l. c. v., 16. *S. procerum*, Roxb. Fl. Ind., i, 243.

Description : A gigantic tufted grass. Culms biennial (? or triennial), somewhat with the habit of the sugarcane, branched, often 5 m. high, the flowering culms sometimes nearly 9 m. high and over 18 mm. diam., solid. Stem glabrous, smooth, or slightly rough with very long internodes. Blade reaching 1·8 m. in length and 5 cm. in breadth, with rib stout and as broad as the blade at base, keeled below, villous with long silky hairs above, margins cutting. (According to Hole the midrib in basal leaves occupies at base ⅓ or less of the width of the blade). Upper cauline leaves becoming folded and filiform. Leaf-sheaths glabrous. Ligule truncate with a ring or tuft of long silky hairs 6–25 mm. distance from its base. Panicle 60 cm. to 1·2 m. long, pink, white or silvery, diffuse while flowering, with smooth glabrous axis, main branches tufted on the axis, tufts alternate or subverticillate. Spikelets 2·5–3·7 mm. long, much shorter than the internodes of the spike. Pedicel ⅓ to equal the length of the sessile spikelet. Joint usually longer than sessile spikelet ; majority of pedicels shorter than proper joint. Callus-hairs pale, not dense, as long as spikelet (according to Hole shorter than or subequal to spikelet). Hairs of joint overtop the joint by less than to 1½ times the length of the joint. Sessile spikelet : Lower involucral glume chartaceous, dorsally sparsely villous, villi overtopping the glume by about 1¼ the length of the glume. Upper involucral glume chartaceous, not villous dorsally. Lower floral glume not villous dorsally. Mucro of upper floral glume not exserted beyond apex of spikelet. Pale ciliate. Pedicelled spikelet : Involucral glumes dorsally villous, villi overtopping spikelet by 1–1½ times the length of the spikelet. Spikelet sometimes 2–3-flowered with 1-2 additional paleate glumes inside the floral glumes.

Locality : Cultivated in gardens.

Distribution : Bengal, Assam, Burma, extending into China. It is a native of the evergreen zone of India characterized by a rainfall exceeding 70 in., but is frequently cultivated in gardens throughout India. (Hole).

4. Saccharum munja, Roxb. Fl. Ind. i (1832), 246 ; Hole in Ind. For. Memoirs, I (1911), 62 ; Haines Bot. Bihar and Orissa 1013.—*S. Sara*, Roxb. l. c. 244.—*S. ciliare*, Anders. in Oefvers. K. Vet. Akad. Förhand. Stockh. (1855), 155 ; Hackel Monogr. Androp. 118, excl. vars. *Griffithii et Boissieri.—S arundinaceum*, Hook. f. in F. B. I., vii, 119 (*partim*).—*S. arundinaceum*, var. *ciliare*, Haines in Fl. Chota Nagpur.

For explanation of above synonymy see Hole, l. c. 65–67.

Description : An erect grass, attaining a height of 5·5 m. and 12 mm. diam., pale straw-coloured, smooth, striate, solid. Leaf-sheath shortly silky at extreme base, otherwise quite smooth, striate, pale straw-coloured, villous on margins at apex with long white hairs usually much longer than proper internode, uppermost sheath sometimes extending beyond the base of the panicle. Upper leaf of flowering culm 22–70 cm. long, flat, tapering from the base, long-acuminate, 5–10 mm. broad. Lower leaves up to 2 and 2·4 m. by 25 mm., but usually only 18 mm. broad. In basal leaves the concave midrib occupies ½ or more of width of blade. Colour glaucous, midrib white. Margin scabrid as are one or more intramarginal nerves below, otherwise smooth, but densely white villous at base behind the ligule. Ligule truncate, usually a narrow membranous rim, of upper leaves longer, attaining 3 mm., minutely silky dorsally and ciliate. Flowering panicle 30–90 cm. long, usually lanceolate, pale cream-coloured to dark reddish-purple, branches spreading. Fruiting panicle oblong, branches appressed to the axis, white to greyish-white. Primary rhachis glabrous, sulcate, more or less scabrid on the ridges. Primary branches subverticillate, compound. Ultimate branchlets triquetrous, more or less villous with long white hairs on angles and on two faces. Spikelets in pairs, one pedicelled and one sessile on the capillary jointed branches and branchlets of a terminal panicle, awnless, lanceolate, up to 5 mm. long ; sessile and pedicelled similar, each one-flowered and hermaphrodite. Pedicelled fruiting spikelet falling from the pedicel, the sessile spikelet falling later with the attached pedicel and joint of axis. Joint of axis triquetrous, ½ to subequal the sessile spikelet, but usually shorter than the spikelet, villous on two faces and on margins, the villi overtopping the joint by once to twice the length of the joint. Pedicels triquetrous, ⅓–¾ the length of the sessile spikelet, villous with long white hairs on two faces and on the angles. Most pedicels shorter than proper joint, rarely subequal to the proper joint. Sessile spikelets : Lower involucral glume lanceolate, chartaceous, with two strong lateral nerves and usually 1-4 more or less distinct additional nerves, dorsally long villous on basal half or two-thirds, the hairs overtopping the glume by about the length of the glume, scabrid dorsally on keels, margin inflexed, sparsely ciliate above, apex minutely bidentate to entire. Upper involucral glume subequal to the lower, lanceolate, chartaceous, keeled, with one strong central nerve and usually 2–4 more or less distinct additional nerves, glabrous dorsally or minutely pubescent towards apex, scabrid dorsally on keel, margins incurved, ciliate above, apex usually shortly mucronate. Lower floral glume oblong-lanceolate, hyaline-membranous or little shorter than the upper involucral glume, 1–3-nerved, margins incurved, ciliate, apex acute or short mucronate. Upper floral glume broad-lanceolate to elliptic, shorter than or subequal to the upper involucral glume, hyaline, 1-3-nerved, mucronate, ciliate, mucro short to 1·25 mm. long, but not exserted beyond the apex of the spikelet. Pale ovate, hyaline, ciliate, from $\frac{1}{3}$–$\frac{3}{4}$ the length of the upper floral glume. Pedicelled spikelets similar, but both the involucral glumes are dorsally long villous and usually with 3–5 strong nerves and occasionally 2 additional fainter ones. Lodicules 2, cuneate, glabrous, 0·5 mm. long. Anthers 3, pale yellow to purple, 2–2·5 mm. long. Stigmas yellow, often tinted with purple, 1–1·5 mm. long.

To distinguish this species from *Saccharum Ravennæ* Hole gives the following field-characters : Glaucous narrow leaves, awnless spikelets, smooth leaf-sheaths.

Locality : Sind (Stocks in herb. Boiss. ex Hackel).—*Gujarat* :– (Sedgwick and Sexton).

Distribution : Northern India in the Punjab and Upper Gangetic Plain.

Uses : The fibre of the upper leaf-sheaths is used for mats, ropes, etc. It has also been favourably reported on as a paper material (Haines).

5. **Saccharum Griffithii,** Munro ex Aitchis. in Journ. Linn. Soc. xix (1822), 191 ; Hole in Ind. For. Memoirs i (1911), 68–70.—*S. Sara,* Aitchis, l. c. 191 ; Boiss. Fl. Or. v, 453.—? *S.Griffithii,* Boiss l. c. 453,—*S. ciliare* var. *Griffithii* Hackel Monogr. Androp. 119.—*Erianthus Griffithii* Hook. f. in F. B. I. vii, 122 (*partim*).

Description : A cæspitose grass. Culms 2 m. high or slightly higher, solid. Blade glaucous, narrow, about 8 mm. wide ; midrib at base usually occupies $\frac{1}{2}$ or more of width of blade ; sheath not hirsute, nodes not bearded. Rhachis of racemes fragile. Spikelets 2 at each node of the rhachis, one sessile and finally decidous with the accumbent joint, the other pedicelled finally separating from the pedicel, both 1-flowered, hermaphrodite. Spikelets 4–6 mm. long, muticous ; pedicel $\frac{1}{3}$–$\frac{2}{3}$ the length of the sessile spikelet ; joint $\frac{1}{4}$–$\frac{2}{3}$ the length of the sessile spikelet. Most pedicels subequal to longer than proper joint ; callus-hairs yellow, shorter than to subequal to the spikelet ; hairs of joint overtopping joint by once to twice the length of joint. Sessile spikelet : Lower involucral glume chartaceous, dorsally densely villous in basal $\frac{2}{3}$, villi not overtopping the glume, or overtopping by less than $\frac{1}{4}$ the length of the glume. Upper involucral glume chartaceous, dorsally villous in basal $\frac{1}{2}$ or $\frac{2}{3}$, villi not overtopping or overtopping by less than $\frac{1}{4}$ the length of the glume. Lower floral glume sometimes sparsely villous dorsally. Upper floral glume with a very short mucro, 1·5 mm. long, not exserted beyond apex of spikelet. Pale ciliate. Pedicelled spikelet : Involucral glumes dorsally villous in basal $\frac{1}{2}$–$\frac{2}{3}$, villi not overtopping or overtopping by less than $\frac{1}{2}$ the length of the spikelet ; no additional glumes inside the floral glumes.

Locality : Sind :—Near Hyderabad (Blatter and McCann D698 !); W. of Tatta (Blatter and McCann D699 !); near Karachi (ex Hackel l.c.).

Distribution : Afghanistan, Baluchistan, Punjab, Sind.

6. **Saccharum Ravennæ,** Linn. Syst. ed. xiii, 88 ; Sibth. & Sm. Fl. Græca, t. 52 ; Reichb. Ic. Fl. Germ., fig. 1505 ; Stapf Fl. Trop. Afr. ix, 97 ; Haines Bot. Bihar and Orissa 1014.—*Erianthus Ravennæ,* Beauv. Agrost 162 ; Roem. and Schult. Syst. ii, 323 ; Hack. Monogr. Androp. 139 ; Hook. f. F. B. I. vii, 121 ; Stapf in Kew Bull. (1907), 208 ; Nees Gen. Fl. Germ. t. 90 ; Boiss. Fl. Or. vi, 455 ; Duthie Grass. N. W. Ind. 15, Fodd. Grass. N. Ind. 26 ; Cke. ii, 949 ; Hole in Ind. For. Memoirs, i (1911), 87.—*Andropogon Ravennæ,* Linn. Sp. Pl. ed. ii, 1481 ; Host. Gram. Austr., iii, 1, t, 1.—*Ripidium Ravennæ,* Trin. Fund. 169.

Description : Culms erect, up to 6 m. high and 17 mm. thick, solid, often slightly fistular just below the panicle, smooth and polished, striate, shortly and finely bearded at the leaf insertions. Leaf-sheath hirsute with bulbous-based hairs, the latter varying in colour from white to yellow or brown, the hairs being more or less deciduous and old sheaths are often rough with the persistent bulbous bases ; upper sheaths glabrescent, always longer than the proper internode, long ciliate on margins towards the apex. Blade of uppermost leaf of flowering culm from 20 cm. long and 6 mm. wide, linear and tapering from base, to 75 cm. long and 16 mm. wide with greatest width about the middle ; lower leaves usually 1·2–1·5 m. long and 25 mm. wide, but also attaining a length of 1·8 m. and width of 38 mm., broadest about the middle, sometimes in upper third, dark green, midrib white, apex acuminate, narrowed towards the base, in basal leaves the concave midrib occupies ½ or more of width of lamina at base, often the entire width of the leaf, densely villous above towards the base with bulbous-based hairs, more or less scaberulous along nerves, margins scabrid. Ligule a narrow membranous rim not longer than 1·75 mm., entire, rounded or deeply 2-lobed, patently hairy dorsally with stiff white hairs, ciliate. Panicle 30–90 cm. long, lanceolate, dense or somewhat lax and lobed, silvery silky, with a tinge of grey and purple, or quite white ; primary rhachis sulcate, glabrous, smooth below, scabrid on the ridges ; branches slender, solitary from the distant nodes, divided from the base, up to 20 cm. long, branchlets unequal, divided again, glabrous except at the nodes. Racemes sessile or the lower more or less peduncled, narrow to oblong ; joints and pedicels filiform, long ciliate, with thickened tips, the latter shorter than the joints. Callus-hairs shorter than to subequal to length of spikelet, purplish or brownish. Sessile spikelet : Lower involucral glume lanceolate with 2 lateral keels, dorsally flat or depressed between the keels, apex 2-mucronulate, one or both margins incurved, dorsally scabrid on keels, otherwise glabrous, or more or less villous dorsally, villi not overtopping the glume, or overtopping by less than ½ the length of the glume, 2-nerved, sometimes with 1–2 additional faint nerves between the keels. Upper involucral glume subequal to the lower, with a central keel, mucronate, margin incurved, ciliate, dorsally scabrid on keel, otherwise glabrous or more or less villous dorsally, villi not overtopping the glume, or overtopping by less than ¼ the length of the glume, 1-nerved and sometimes 1 or 2 partial lateral nerves. Lower floral glume slightly shorter than upper involucral glume, oblong-lanceolate, hyaline, apex mucronate or acute, dorsally glabrous , margin incurved, ciliate above, 1-3-nerved. Upper floral glume usually ¾ the length of the lower, ovate-lanceolate, hyaline, margin incurved, ciliate, long-awned, awn 2·5–6 mm. long, 3-nerved. Pale about ¾ the length of the upper floral glume, ovate-lanceolate, hyaline, glabrous, nerveless. Lodicules 2, cuneate, glabrous. Anthers 3, yellow streaked with purple. Stigmas yellow. Pedicelled spikelet like the sessile, but involucral glumes often strongly 3-nerved and hairy.

Can easily be distinguished from *Saccharum munja* by its distinctly awned spikelets, the broader dark green leaves and hairy leaf-sheaths. (Hole).

Locality : Sind—Laki (Bhide !) ; Khairpur Mirs, sandy plain (Sabnis B226 !) ; Sehwan (Sabnis B36 !, B664 !) ; Larkana (Sabnis B444 !, Cooke) ; Pad-Idan (Sabnis B498 !, B509 !) ; Sukkar (Sabnis B552 !) ; Nasarpur, sandy plains (Sabnis B1049 !) ; Umarkot, sandy plains (Sabnis B1211 !) ; Sanghar (Sabnis B900 !) ; Jamesabad (Sabnis B968 !) ; Phuleli Canal, on banks (Sabnis B195 !) ; Mirva Canal, sandy banks (Sabnis B258 !) ; Khairpur forests (Sabnis B329 !) ; Sita Road (Sabnis B367 !) ; Sehwan to Laki, foot of hills (Sabnis B60! , B111 !) ; Mirpur Sakro (Blatter and McCann D694 !) ; Chuar Chemali (Blatter and McCann D695 !) ; Indus Delta (Blatter and McCann D696 !) ; Karachi (Cooke, Woodrow).—*Deccan* : College Garden, Poona (Garade !).

Distribution : Western Himalaya, Punjab, Upper Gangetic Plain, Sind, extending westwards to the Mediterranean.

Uses : The culms are used for making screens, etc. The leaves quickly decay and are therefore useless for thatching.

7. **Saccharum fastigiatum,** Steud. Syn. Gram. (1855), 409 ; Haines Bot. Bihar and Orissa, 1014. *Erianthus fastigiatus,* Nees ex Steud. l. c. ; Hack. Monogr. Androp. 150 ; Hook. f. in F. B. I., vii, 125 ; Cke. ii, 949.

Description : Cke. l. c.

Locality : S. M. Country :—Belgaum (Ritchie 792).

Distribution : Sikkim, Khasia, Assam, Bengal, Chota Nagpur, Orissa, W. Peninsula.

23. SPODIOPOGON, Trin., Cke. ii, 947.

Spodiopogon albidus, Benth. in Journ. Linn. Soc. 19 (1881), 66 ; Hackel Monogr. Androp, 185 ; F. B. I. vii, 108 ; Cke. ii, 947.—*Andropogon rhizophorus* Steud. Syn. Gram. 381 ; Duthie Fodd. Grass. N. Ind. 26.—*Andropogan petiolatus,* Dalz. Bomb. Fl. (1861), 303.

Description : Cke ii, 947.

Locality : Khandesh : Toranmal (McCann 9886 !, 9888) ;—*Konkan :* W. Ghats (Woodrow 157) ; Warsai, near Penn (Bhide !) ; Penn (McCann 5374A !) ; Below Palli Hill, Bandra (Ryan !) ; Tungar, Bassein (Bhide !) ; Salsette (Jacquemont 708) ; Matheran (Cooke) ; Matheran, Harrison's Springs (D'Almeida A242 !).—*Deccan* : Lonavla (Bhide !, McCann !, Woodrow) ; Khandala, very common (McCann, 9401 !) ; Khandala to Karjat (Blatter and Hallberg 5325 !); Ganeshkhind Bot. Gardens, Kirkee (Gammie !) ; Sinhagad Forest, Poona District (Bhide !) ; Lohagad, upper half (McCann 9437 !) ; Purandhar Fort (McCann 5004 !); Igatpuri, common (McCann 4327); Mahableshwar (Cooke); Mahableshwar to Pratapgad (Bhide 1182 !).—*S. M. Country :* Derikop, forest (Sedgwick 1862 !).—*Kanara :* (McCann !) ; Arbail Ghat (Sedgwick and Bell 3168 !) ; Suppa (Talbot, 279 !).

Distribution : Central Provinces, Rajputana, W. Peninsula.

24. POGONATHERUM, Beauv., Cke. ii, 965.

1. Hairs of callus longer than the spikelet...1. *P. crinitum.*
2. Hairs of callus shorter than the spikelet...2. *P. saccharoideum.*

1. **Pogonatherum crinitum,** Kunth Enum. Pl. 1 (1833), 478 ; Hook. f. in F. B. I. vii, 141 ; Cke. ii, 965.—*P. saccharoideum* var. *monandrum,* Hack. Monogr. Androp. 193.—*P. polystachyum,* Kunth Revis. Gram. 493.—*P. refractum,* Nees in Hook. et Arn. Beechy's Voy. 239.—*Pollinia monandra,* Spreng. Syst. i, 288.—*Pogonopsis tenera,* Presl. Rel.Hænk. i, 133, t. 46.-*Ischæmum crinitum,* Trin. in Mem. Acad. Petersb. ser. vi, ii (1833), 298.—*Andropogon crinitus,* Thunb. Fl. Jap. 40, t. 7.—*A. monandrus,* Roxb. Fl. Ind. i, 260.—*Pogonatherum,* Griff. Notul. iii, 81, Ic. Pl. As. t. 145, fig. 2.

Description : Cke. ii, 965.

Locality : Kanara : Sirsi (Gammie !); Sumpkund, in a cutting (McCann 9947 !, Woodrow !); Nilkhund Ghat on steep bank along roadside (Talbot 781 !) ; Gersoppa Falls (Talbot 2671 !, McCann, 9939 !).

Distribution : More or less all over India, Afghanistan, China, Malaya, New Hebrides.

*2. **Pogonatherum saccharoideum,** Beauv. Agrost. 56, t. 11, fig. 11 ; Duthie Grass. N. W. Ind. 16, Fodd. Grass. N. Ind. 27 ; F. B. I. vii, 141 ; Cke. ii, 966 ; Haines Bot. Bihar and Orissa, 1017.—*P. saccharoideum* var. *genuinum,* Hack. Monogr. Androp. 193.—*P. polystachyum,* Roem. and Sch. Syst. ii, 497.—*Pollinia polystachys,* Spreng. Syst. i, 288 ; Kunth Rev. Gram. 493, t. 162.—*Saccharum paniceum,* Lamk. Encycl. i, 595, illust. t. 40. fig. 31.—The Bamboo Grass.

Description : A much tufted, branched and very leafy elegant grass, 30–60 cm. high ; stem firm or almost woody, slender, polished, from a perennial woodstock ; nodes on stem glabrous or bearded. Leaves 2·5–6·5 cm. long up to 2·5 mm. broad, linear, acuminate, bearded at the base and margins of sheaths. Spikes 17 mm. to 5 cm. long, terminating all the branches ; rhachis compressed and pedicel bearded ; each spikelet with 2 long fine scaberulous awns 15–25 mm. long. Sessile spikelet : Lower involucral glume narrow-oblong, broadest above, faintly 2-4-nerved, tip bearded. Upper involucral glume the largest, conduplicate, 2·5 mm. long, 1-nerved, keel produced into a long awn, tip densely ciliate. Lower floral glume sometimes absent. Pale of upper floral glume broadly ovate-oblong, much exceeding the minute ovary. Pedicelled spikelet about ⅔-¾ the length of the sessile.

Locality : Grown in gardens.

Distribution : Hilly parts of India from the Punjab to Bhutan, Burma and China, southwards to Central India and Ceylon, Malaya.

25. EULALIA, Kunth ; Stapf Fl. Trop. Afr. ix, 97.

(Formerly under *Pollinia,* Trin.—Cke. ii, 950).

Perennial. Culms simple, erect or ascending. Leaf-blades convolute when young, then flat, usually narrow, gradually passing into the sheath. Racemes often coloured, brown or purplish. Spikelets all alike or nearly so, one sessile, the other pedicelled on the articulate fragile rhachis of 2-nate, digitate or fascicled spike-like racemes, the pedicelled falling from their pedicels, the sessile deciduous together with the contiguous joint of the rhachis and the pedicel. Involucral glumes equal or somewhat unequal, rigidly membranous to coriaceous, the lower dorsally flattened or shallowly concave (never grooved), more or less 2-keeled with inflexed margins, the upper 1-3-nerved, keeled. Lower floral glume empty, sometimes much reduced, muticous, hyaline; upper floral glume very short, 2-lobed, awned, pale small or 0. Lodicules small, cuneate. Stamens 3. Stigmas linear, laterally exserted. Grain oblong; embryo almost half the length of the grain or longer; hilum basal, punctiform.

Species about 25, in the tropical and subtropical regions of the Old World.

1. Racemes many, 6–12..1. *E. argentea.*
2. Racemes few, 2–4 ....2. *E. fimbriata.*

1. **Eulalia argentea**, Brogn. Voy. Coq. Bot. 92; Haines Bot. Bihar and Orissa, 1018.—*Pollinia argentea*, Trin. in Bull. Sc. Acad. Petersb. i (1836), 71; Hackel Monogr. Androp. 162; Hook. f. in F. B. I. vii, 111; Cke. ii, 950. — *P. tristachya*, Thw. Enum. Pl. Zeyl. 368 (*partim*); Duthie Fodd. Grass. N.W. Ind. 26, t. 53.—*Erianthus hexastachyus*, Hochst. in Hohen. Pl. Ind. Or. no. 279. —*E. Roxburghii*, F. Muell. Fragm. Phyt. viii, 117.—*Andropogon tristachyus*, Roxb. Fl. Ind. i. 256.

Description: Cke. ii, 950.

Locality: *Khandesh*: Tapti Valley, railway line (Bhide!).—*Konkan:* Ratnagiri (Woodrow); Near Ratnagiri (Herb. Econ. Bot. Poona!); St. Xavier's College compound, Bombay (McCann 4510!); Parsik Hill (McCann 9715!); above Kenery Caves (McCann 9723!); Ghatkoper, Horse-shoe Valley (McCann 9891!); Marine Lines, Bombay (Hallberg 9889!); Bassein (McCann 9475!); Vetora (Sabnis 33507!).—*Deccan:* Lonavla (Bhide!, McCann!, Woodrow, Lisboa); Khandala, very common (McCann 9716!); Lohagad, way up (McCann 9718!; Panchgani (Blatter 5388!, Blatter and Hallberg B. 1213!, McCann!); Mawal (Woodrow).—*S. M. Country:* Dharwar District (Sedgwick 2112!); Dastikop (Sedgwick 2088!); Castle Rock (Bhide!, McCann A. 304!).—*Kanara*: Suppa Taluka (Talbot 2257!); Jugglepet (Talbot 1569!); Yellapore (Talbot 1525!); Halyal (Talbot 2224!); Kumberwada (Talbot 2257!); Dandeli (Talbot 2267!).

Distribution: Throughout India, Ceylon, Malaya, Australia.

2. **Eulalia fimbriata**. Blatter and McCann, *comb. nova.*—*Pollinia fimbriata*, Hackel Monogr. Androp. 164; Hook. f. in F. B. I. vii, 112; Cke. ii, 950.

Description: Cke. l. c.

Locality: Konkan: Dahe Forest (Ryan 708!); Uran (McCann, 5123!); Trombay (McCann 305!); Matheran, Monkey Point (D'Almeida A. 254!, A. 255!).—*Deccan:* Lonavla (Chibber 11!, Woodrow 173); Khandala, common (McCann 5300!).

Distribution. W. Himalaya, W. Peninsula, Pegu.

26. SORGHUM, Pers. Syn. i, 101; Stapf Fl. Trop. Afr., ix, 104.

Annual or perennial, often robust, grasses. Leaf-blades convolute in bud, usually flat, herbaceous, often large. Panicles erect or nodding with verticillate or scattered branches, often large, in the spontaneous species mostly loose, in the cultivated forms frequently variously contracted to compact. Spikelets 2-nate, those of each pair differing in shape and sex, one sessile, the other pedicelled or represented by a pedicel only, on the articulate fragile or (in cultivated forms) tough rhachis of panicled few-(sometimes-1 or, the other extreme, 6–8-) jointed racemes, the sessile spikelet falling with the contiguous joint and the accompanying pedicelled spikelet or at least its pedicel. Florets 2, lower reduced to an empty valve, upper hermaphrodite in the sessile, male or neuter in the pedicelled spikelets, if present at all. Sessile spikelet: Involucral glumes equal, coriaceous, at least when mature, rarely permanently chartaceous, muticous. Lower with a broad flattened or convex back with the margins narrowly inflexed near the tips and elsewhere involute. Upper cymbiform with narrow hyaline, usually upwards ciliate margins. Lower floral glume empty, hyaline, ciliate, 2-nerved or nerveless. Upper oblong to ovate, 1–3-nerved, 2-lobed or dentate, with the lobes free or more or less adnate to a perfect or variously reduced awn or a mucro rising from the sinus, rarely entire and mucronate or muticous. Pale hyaline, often minute or 0. Lodicules 2, ciliate or glabrous. Stamens 3. Stigmas laterally exserted; styles terminal or subterminal. Grain in the wild species mostly obovoid, dorsally compressed, in cultivated forms frequently enlarged, globose or subglobose; embryo as long or slightly longer than half the grain. Pedicelled spikelets, if present, much narrower than the sessile, lanceolate to subulate, male or neuter sometimes reduced to the glumes or one glume only or quite suppressed. Involucral glumes permanently herbaceous, awnless like the hyaline 2–1-nerved ciliate floral glumes.

According to Stapf (Fl. Trop. Afr., ix, 105) there are about 35 wild species in the tropical and subtropical regions of both hemispheres, very few extending into the temperate zones. One group of forms is widely cultivated in the tropics, particularly in Africa.

The classification of the material belonging to the section *Eu-sorghum* forms a difficult problem, which we are not prepared to tackle at present. The difficulties are well explained by Stapf (l.c.), and we cannot refrain from quoting the passage, though somewhat lengthy, because it may be a help to workers on this genus and induce them, at the same time, to subject the vast material available in the Presidency to a more scientific examination and exact taxonomic treatment, by which Botany as well as Agriculture will profit.

Those species, says Stapf, ' which come under consideration in this work (Flora of Tropical Africa) have with two exceptions (*S. purpureo-sericeum* and *S. versicolor*) been placed by Hackel in one vast species, *Andropogon Sorghum*, the leading idea being that they were all derived from one wild ancestor, the old *Holcus halepensis*, Linn. Piper, however, has recently advanced good reasons why this is extremely improbable. He has pointed out that the Linnean *Holcus halepensis* (*Andropogon Sorghum*, subsp. *halepensis*, var. *genuinus*, Hack.) is a perennial type almost confined to the Mediterranean region (*sensu lato*) and absent from tropical Africa which is the home of most of the spontaneous annual forms and probably also the cradle of most of the cultivated races known collectively as Guinea corn (*Andropogon Sorghum*, subsp. *sativus*, Hack.). To these spontaneous annuals and the cultivated forms he confines the name *Andropogon Sorghum*, and dealing in particular with the former he groups them under 11 subspecies, whilst he abstains from attempting to classify the latter. Most of Piper's subspecies are here recognized as definite units, but with the status of species, a procedure which seems to have the advantage of simplicity and directness, whilst it leaves the door open to any theoretical grouping which may in the future be desirable. The same reasoning has been applied to the cultivated forms. Hence the breaking up of Hackel's *Andropogon Sorghum*, var. *sativus*. Koernicke, who made the first comprehensive attempt to classify them, relied for that purpose exclusively on characters exhibited by mature infructescences, especially their degree of looseness or contraction and the colours of the ripe glumes and grains ; but Hackel in his monograph introduced characters taken from the shape of the spikelets. The grain being in most cases the thing aimed at in the evolution of these very numerous races, it is clear that artificially introduced modifications must from the beginning have tended in the grain-state to obscure or repress the phytogenetically important features in so far as they were economically indifferent or undesirable. It seemed therefore, more promising to base the primary grouping on the comparison of the flowering stages, which might be expected to be more or less outside the influence of the artificially moulding forces of man. Within these primary groups, which are treated here as species, nothing more than a purely artificial arrangement can for the present be attempted. An exhaustive treatment of the hundreds of races which have been given distinctive popular names would, even if it were possible, be beyond the scope of a colonial flora.'

If Stapf, with all the facilities of Kew and the British Museum and other European herbaria at his disposal, complains about ' the very rudimentary state of our knowledge and of our collections ' nobody can reasonably expect that we should bring order into the chaotic state of the *Sorghum* question in India. Years of intensive study of Indian and African forms are required to bring the intricate problem nearer its solution.

For the present we follow Haines in retaining the old species of *S. halepense* and *S. vulgare*. Of species not known from the Presidency before we add *S. subglabrescens*, Schweinf. & Aschers. and *S. nitidum*, Pers. This, we admit, is not quite satisfactory, but it is all we can offer at the present state of our knowledge and with the material at our disposal in India.

In order to enable Indian botanists to utilize Stapf's and Piper's investigations in the further study of the genus *Sorghum* we shall add, in the way of an appendix, the descriptions of those species which Stapf has described from tropical Africa and which have also been observed in India, whether in the

Presidency or outside it. It is only in this way that we shall be able to co-ordinate the knowledge obtained on so widely spread a genus like *Sorghum* and it would not help botanical science to start the investigations of Indian *Sorghums* on independent lines without constant reference to the work done in other fields. It might be easier and perhaps also more convenient for certain practical purposes, but on the whole certainly less scientific and in the long run more confusing.

A. Wild species
  I. Racemes up to 4-noded
    1. Primary branches of panicle divided
      (*a*) Stems up to 4·5 m. high ... 1. *S. halepense.*
      (*b*) Stem about 75 cm. high ... 2. *S. subglabrescens.*
    2. Primary branches of panicle simple ... 3. *S. purpureo-sericeum.*
  II. Racemes 2–8-noded ... ... 4. *S. nitidum.*
B. Cultivated species ... ... 5. *S. vulgare.*

1. **Sorghum halepense**, Pers. Syn. i (1805), 101.—*Andropogon halepensis*, Brot. Fl. Lusit. i (1804), 89; Hook. f. in F.B.I. vii, 182; Cke. ii, 983; Haines Bot. Bihar and Orissa 1033.

Vern. Names : Boru, baru; called Johnson Grass in America.

Description : Cke. l. c.

Locality : Gujarat : Ahmedabad (Gammie 16389!); Perim Isl., Gulf of Cambay (Blatter 3813!).—*Khandesh :* Toranmal (McCann 9643!); Khadgaum (McCann 9642!).—*Konkan :* Bassein Fort (Chibber 138!); Kase forest, Dhann Range (Ryan 1919!); Vetora (Sabnis 33072!); Trombay (McCann A. 269!); Byculla (McCann 9656!).—*Deccan :* Ganeshkhind Botanic Gardens (Herb. Econ. Bot. Poona!); Purandhar (McCann 5001!); Khandala, railway line near Rama's Bed (McCann 9426!); Panchgani (Blatter and Hallberg B. 1302!).—*S. M. Country:* Kunnur, 2,000 ft., rainfall 35″ (Sedgwick and Bell 4984!); near Kilgerry (Talbot 2617!).—*Kanara :* Halyal Fort (Talbot 2006!).

Distribution : Most warm countries.

Uses: A good fodder grass. The grain is eaten. See Vinalle, H. N.: A study of the literature concerning poisoning of cattle by prussic acid in *Sorghum*, Sudan grass and Johnson grass, Journ. Amer. Soc. Agron. 13 (1921), 267–80. Gives remedies for hydrocyanic acid poisoning.

2. **Sorghum subglabrescens,** Schweinf. & Aschers. in Beitr. Fl. Aethiop. 302, 306; Stapf in Fl. Trop. Afr. ix, 137.—*Andropogon subglabrescens*, Steud. Syn. Pl. Glum. i, 393.—*A. Sorghum*, subsp. *sativus*, var. *subglabrescens*, Hack. in Monogr. Androp. 519; Chiovenda in Ann. Istit. Bot. Roma vii, 25.

Description : Annual. Culms (Stapf saw only a meagre specimen) slender, almost simple, 75 cm. high, about 8-noded, internodes, except the uppermost, shorter than the sheaths. Leaf-sheaths finely pubescent at the nodes; ligules very short, shortly ciliate from the back; blades linear from a broad (middle and upper leaves) or slightly narrowed (lower leaves) base, long-attenuated upwards, up to 20 by 1·7 cm., green, flushed with red, quite glabrous. Panicle oblong, erect, 8·5 by almost 2·5 cm., contracted, moderately dense; branches scattered, erect, the longest not much over 2·5 cm., long and undivided for about 12 mm. from the base, almost simple, scabrous to spinulously ciliate, sparingly hairy at the base. Racemes tough, up to 4-noded and 8·5-10·6 mm. long, dense; joints rather stout, up to 2 mm. long, shortly whitish-ciliate; pedicels very similar, up to 1 mm. long. Sessile spikelet oblong, actue in flower, broad-ovoid or ellipsoid in fruit, 6·3 by 3·3 mm., at length variegated, awned; callus-beard scanty, 1 mm. long. Involucral glumes equal, gaping when mature, more or less coriaceous and glossy in the lower third, spongy-subcoriaceous and constricted about the middle, then papery, more or less whitish strigillose, at length sometimes almost glabrous; lower finely 13-nerved, nerves showing above the coriaceous base, keels rather sharp, scabrid, running into minute teeth, between which the minute hyaline tip protrudes, the coriaceous part rich maroon to almost black, followed by a pale transverse zone, then violet or purple across the middle, the broad triangular somewhat depressed tip straw-colour or reddish upwards; upper glume almost as broad as the lower, 9-nerved, slightly keeled, coloured like the lower. Floral glumes ciliate; lower broad-oblong, up to almost 5·3 mm. long; upper ovate, subentire, 3·3 mm. long, awn up to 12·7 mm. long, sharply bent, column stout, twisted, equalling the bristle. Grain exposed upwards between the gaping glumes, equalling or slightly exceeding them, obovoid, 4·2 mm. long, more or less orange; embryo-mark and nerves obscure. Pedicelled spikelet neuter, persistent, linear-lanceolate, acute, 5·3 mm. long and more, reddish, lower involucral glume up to 11-, upper 7-nerved.

Locality : Mahratta Country (Young, ex Stapf).

Distribution : Abyssinia, tropical Arabia.

Note : According to Stapf the specimen from India is a smaller variety of the type just described.

3. **Sorghum purpureo-sericeum**, Aschers. & Schweinf. in Schweinf. Beitr. Fl. Aethiop. 302, 306; Stapf in Fl. Trop. Afr., ix, 140.—*Andropogon purpureo-sericeus*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii (1851), 469; Hack. in Monogr. Androp. 524; Hook. f. in F. B. I. vii, 185; Cke. ii, 984.

Description : Cke. l.c.

Locality : Gujarat: Garvi Dangs, in a field (Herb. Econ. Bot. Poona !).—*Khandesh* (Herb. Econ. Bot. Poona !); Bhusawal (McCann 5224 !).—*Deccan :* Poona, above the Ghats (teste W. Burns).—*S. M. Country :* Kolhapur (Woodrow !); Belgaum (Ritchie 887).—*Kanara* : N. Kanara (Woodrow 40 !).

Distribution : Central Provinces, W. Peninsula, tropical Africa.

4. **Sorghum nitidum**, Pers. Synops. i, 101; Haines Bot. Bihar and Orissa 1034. —*Andropogon nitidus*, Kunth, Revis. Gram. i, 166.—*A. serratus*, Thunb. Fl. Jap. 41; Hack. in Monogr. Androp. 520.—*Anatherum nitidum*, Spreng. Syst. i, 290.—*Andropogon fuscus*, J. S. Presl in C. B. Presl, Reliq. Haenk. i, 342.—*A. consimilis*, Steud. Syn. i, 394.—*A. pedicellatus*, Steud. l. c. 394.—*Holcus fulvus*, R. Br. Prodr. 199.—*Sorghum fulvum*, Beauv. *ap*. Roem. *et*. Schult. Syst. ii, 840.—*Chrysopogon fuscus*, Trin. in Steud. Nomencl. ed. 2, 360.

Description : A tall tufted grass, 1–2·4 m. high, densely villous at the nodes. Leaves 10–75 cm. by 8–20 mm., setaceously acuminate, glabrous or sparsely hairy on both surfaces, hairs often tubercle-based, midrib broad, prominent, white; sheaths terete below, keeled upward, more or less hairy; mouth silky-villous; ligule very short, truncate. Panicle 10–30 cm. long, oblong, lax, subsimple, rhachis glabrous, branches capillary, about equalling the spikes, glabrous or scaberulous, whorls distant. Spikes 8–37 mm. long, red-brown; joints and pedicels ½ to ⅔ the length of the sessile spikelets, margins shortly villous. Sessile spikelets broadly ellipsoid, callus rounded (Haines), or acute (Hook. f.). Lower involucral glume coriaceous, broadly oblong or elliptic acute or obtuse, dorsally flattened with incurved margins, brown-hairy and keels hispid, 7-nerved, or about 3-nerved between keels, sometimes nearly black, polished. Upper involucral glume broadly cymbiform with rounded back, lanceolate, acute, 1-nerved, hairy upwards. Lower floral glume as long as or shorter than the upper involucral glume, hyaline, margins inrolled, 2-keeled, ciliate; upper floral glume linear-oblong, 2-lobed, awned or not. Pedicellate spikelet linear-oblong, pale or greenish with brown hairs. Lower involucral glume oblong, rounded or sub-truncate, dorsally depressed and 2-nerved between the keels; upper equal, rather narrower, obtuse margins much inflexed, 3-nerved between keels. Lower floral glume hyaline, linear.

Locality : Kanara : Tinai (Talbot 2574 !); Sambiani (Talbot 1337 !); Sirsi to Sidderpur (Hallberg and McCann A 270 !).

Distribution : India, Ceylon, Nicobars, Asia, tropical Australia.

5. **Sorghum vulgare**, Pers. Syn. i, 101; Haines Bot. Bihar and Orissa 1033. —*Andropogon Sorghum*, Brot. Fl. Lus. i, 88.

Description : Stout, usually tall annual grasses. Leaves broadly linear with a prominent white midrib. Panicle usually thyrsiform decompound with crowded whorls of erect branches and branchlets, rarely subeffuse. Rhachis of spike tenaceous, joints when forcibly separated leaving a ragged scar at the tip. Pedicelled spikelets usually neuter, pedicels short.

This is the Great Millet or Jowar, cultivated in most parts of the Presidency. (See H. H. Mann, Fodder Crops of W. India. *Dept. Agr. Bombay, Bull.* 77 of 1916, and G. L. Kottur, Classification and Description of the Jowars of the Bombay Karnatik, *Dept. Agr. Bombay Bull.* 92 and others.)

After what we have said above we do not consider it advisable to enter into a description of the numerous varieties and forms. But we may mention in this place that a variety common in the Presidency, viz. *S. vulgare* var. *Roxburghii*, Hackel in Monogr. Androp. 510 has been described as a species by Stapf under the name of *S. Roxburghii* in Fl. Trop. Afr., ix, 126. The description will be given in the following appendix to the genus *Sorghum*.

Species of *Sorghum* described from Africa by Stapf which also occur in India. All the information is taken from Stapf, mostly almost verbatim.

A. Mature sessile spikelets deciduous with the adjoining joint of the rhachis and its pedicelled companion : spontaneous grasses 1. *S. verticilliflorum.*
B. Mature sessile spikelets persistent : cultivated grasses
  I. Mature glumes wholly coriaceous or the lower with a herbaceous triangular tip, its nerves not visible on the back except at the tip, particularly when this is herbaceous
    1. Mature panicles more or less loose, usually with arched or drooping branches, never quite compact
      (*a*) Sessile spikelets ovate or elliptic to lanceolate-oblong
        * Mature spikelets pale straw-colour, permanently more or less hairy ; the grain embraced below by the tightly appressed glumes ... 2. *S. Roxburghii*, var. *semiclausum.*
        ** Mature spikelets bright tawny early glabrescent ; the grain almost wholly exposed between the involute glumes... 2. *S. Roxburghii*, var. *hians.*
      (*b*) Sessile spikelets broadly obovate in outline ... 3. *S. bicolor*, var. *obovatum.*
    2. Mature panicles very dense to compact, rarely more or less loosened owing to the reduction of the primary axis and the consequent subdigitate arrangement of the branches ... 4. *S. Durra.*
  II. Mature glumes thinly crustaceous to papery, the tips brittle and breakng irregularly. Back of spikelets longitudinally striate.
    1. Sessile spikelets 6·3–8·5 mm. long. Pedicelled spikelets 7·6–10 mm. long ... 5. *S. papyrascens.*
    2. Sessile spikelets 5—6·3 mm. long. Pedicelled spikelets up to 6·3 mm. long 6. *S. cernuum.*

* 1. **Sorghum verticilliflorum,** Stapf in Fl. Trop. Afr. ix, 116.—*S. halepense*, Nees Fl. Afr. Austr. 88, *non* Pers.—*Andropogon verticilliflorus*, Steud. Syn. Pl. Glum. i, 393.—*A. Sorghum*, subsp. *halepensis*, var. *effusus*, Hack. in Monogr. Androp. 503 (*partim*).—*A. Sorghum verticilliflorus*, Piper in Proc. Biol. Soc. Wash. xxviii, 37.—*A. halepensis*, var. *effusus*, Stapf in Dyer, Fl. Cap. vii, 346 (*partim*).

Description : An annual. Culms 1·2–2·4 m. high, sometimes slightly pruinose below the nodes. Leaf-sheaths delicately silky-pubescent at the nodes ; ligules up to over 2 mm. long, scarious, hairy on the back ; blades linear from a broad rounded and often clasping base, long attenuated upwards, up to 45 cm. long, rarely over 25 mm. wide, green, sometimes slightly glaucous or flushed with purple, hairy just behind the ligule, otherwise glabrous. Panicle oblong to ovoid-oblong, often rather contracted and more or less nodding at first, then spreading out and more erect, up to 37 cm. long and ultimately 15–22 cm. wide ; branches slender, flexuous, whorled, longest up to 22 cm. long and undivided to up to 5, rarely 7·5 cm. from the base, distantly branched, slightly and shortly hairy to villous at the base, like the branchlets more or less rough, at least upwards. Racemes fragile, up to 5-, but mostly 2- or 3-noded, rarely over 18 mm. long ; joints slender, 3·3–4·2 mm. long, shortly ciliate, cilia dirty white or pale fulvous, often with a tinge of purple ; pedicels similar, slightly shorter, their tips subdiscoid. Sessile spikelet ovate to ovate-lanceolate, shortly acuminate to acute, 3·7–4·5 mm. by 1·5–2·2 mm., straw-coloured, greenish towards the tips (at least when young), sometimes tinged with purple, ultimately often turning bright or blackish-red particularly below ; callus-beard less than 1 mm. long. Involucral glumes equal, coriaceous, slightly glossy below (more so when ripening), thinner upwards, lower usually slightly bulging below and somewhat depressed towards the tips, 11–13-nerved, with the nerves very obscure near the tips or more or less marked, sharply 2-keeled and scabrid to spinulously ciliolate in the upper half or third, more or less strigillose, often glabrescent, rarely almost glabrous, hairs pale whitish or fulvous, loosely appressed, upper sharply keeled towards the tips with the keel rough, 7-nerved, more or less hairy. Floral glumes conspicuously ciliate, lower lanceolate, 5·3 mm. long, upper ovate, shortly 2-lobed, 2·2 mm. long ; awn fine, 1·3–1·7 cm. long. Anthers 3·3 mm. long. Grain obovate-oblong, 3·3 mm. by 0·2 mm., fuscous, paler below ; embryo-mark distinct, hardly exceeding the middle of the grain. Pedicelled spikelet male or neuter, early deciduous, subulate-lanceolate to linear, acutely acuminate, 6·3 mm. long, pale greenish, often tinged with red or purple ; lower involucral glume 9-, upper 5-nerved.

Distribution : Nileland, Mozambique District, Natal, the Comoros, Seychelles, Madagascar, the Mascarenes. Introduced into India as Tabucki grass, also to Australia, Polynesia, and the West Indies.

* 2. **Sorghum Roxburghii,** Stapf in Fl. Trop. Afr. ix, 126.

Description : Annual. Culms stout, tall, often slightly waxy, pruinose below the nodes. Leaf-sheaths softly pubescent at the nodes ; ligules very short, scarious, hairy from the back ; blades linear to linear-lanceolate from a broad clasping base, long-attenuated upwards, up to over 45 cm. long and up to 37 mm. wide, usually hairy to tomentose inside above the ligule and outside at the junction with the sheath, otherwise glabrous. Panicle oblong to ovoid-oblong, rarely subovate or elliptic in outline, erect, contracted and dense (rarely lax) in flower, somewhat to much loosened when mature ; branches slender, flexuous, whorled or semiverticillate, the longest undivided for up to 12–25 mm. (rarely much more) from the base, more or less ciliate towards the base and often villous at the junction with the nodes, otherwise like their divisions glabrous or nearly so, finely scabrid upwards. Racemes tough, up to 4- (rarely 5-) noded, 8–12 mm. long ; joints slender, 2–3·3 mm. long, distinctly and often densely ciliate, cilia white or purplish ; pedicels similar but more slender, of about the same length or more often shorter with very slightly thickened tips. Sessile spikelet ovate, acute, with a small fine point, sometimes flattened on the back when young but soon convex, about 5·3 mm. by 2·7-3·3 mm., permanently pale or dull straw-coloured to tawny, at length slightly glossy ; callus-beard, white. Involucral glumes equal, coriaceous, lower about 10–13-nerved, finely and often obscurely 2-keeled towards the tips with the keels slightly scabrid, transversely constricted at the base, more or less white-strigillose (to almost tomentose) when young, at length more or less glabrescent on the back, upper 7–9-nerved, finely keeled upwards, tip usually straight. Floral glumes distinctly ciliate, cilia up to 1 mm. long, lower broad-oblong, as long as the glumes, upper broad-ovate, 3·3–4 mm. long, middle nerve much thickened from the middle upwards, running out into a short straight mucro, lobes adnate to it almost all along. Anthers 2·7 mm. long. Grains elliptic or ovate-elliptic in outline, 3·8–4·8 mm. by 2·7–3·3 mm.. dull white (in the African specimens). Pedicelled spikelet usually neuter, linear or linear-lanceolate, up to 4·2 mm. long, more often much reduced and quite small, persistent ; lower involucral glume, if well developed, up to 9-nerved, upper 5-nerved.

Of this species Stapf describes two varieties which also occur in India.

(*a*) Var. **semiclausum,** Stapf in Fl. Trop. Afr. ix, 127.–*Holcus Sorghum minus et Sisna*, Wall. Cat. 8777 F. A.—*Andropogon Sorghum*, subsp. *sativus*, var. *Roxburghii* (?) and *fulvus*, Hack. in Monogr. Androp. 510 and 512.—*A. Sorghum*, var. *Usorum* (?). Stapf in Dyer Fl. Cap. vii, 348, *in nota* ; Medley Wood, Natal Pl. ii, t. 120, *non* Koern. *neque* Hack.

Description : Panicles fairly dense, also when mature. Involucral glumes less coriaceous towards the tips and more or less showing the nerves in that portion, permanently more or less strigillose, their margins clasping the grain so that only its top or upper half is exposed.

Distribution : Nileland of tropical Africa, Mozambique District, Natal, Madagascar, India.

(*b*) Var. **hians**, Stapf l. c. 127.—*Holcus Sorghum nitidum*, Wall. Cat. 8777D.—*Andropogon Sorghum*, var. *hians*, Stapf in Hook. f. F. B. I., vii, 184.—*A. Sorghum*, var. *Roxburghii*, K. Schum. in Engl. Pfl. Ost. Afr. B, 48 ; C. t. iv, F-H ; Busse and Pilger in Engl. Jahrb. xxxii, 184, *partim.*

Description : Panicles more or less loose with very flexuous and often drooping branches. Involucral glumes coriaceous to the tips with the nerves quite obscure, subglabrous and somewhat glossy on the back when mature, their margins involute, exposing the whole grain, which is often placed with its back and front parallel to the median line of the spikelet.

Distribution : Mozambique District ; also in India.

* 3. **Sorghum bicolor,** Moench Meth. 207, var. **obovatum**, Stapf in Fl. Trop. Afr. ix, 127.—*S. bicolor*, Willd. Enum. Hort. Berol. 1036.—*S. nigrum,* Roem. & Schult. Syst. ii, 837.—*S. vulgare bicolor*, Pers. Syn. i, 101.—*S. vulgare*, var. *obovatum*, subvar. *nigrum*, Rendle in Cat. Afr. Pl. Welw. ii, 151.—*S. rubens,* Willd. Enum. Hort. Berol. 1036.—*Holcus bicolor*, Linn. Mant. Alt. 301.—*H. Sorghum*, Mieg. in Act. Helv. viii, 129, t. 4. f. 4.—*H. niger*, Ard. in Sagg. sc. e lett. acad. Padova, i, 134, t. 5.—*H. saccharatus*—Gaertn. Fruct. ii, 3, t. 80. fig. 2 (?), *non aliorum auctorum.*—*Andropogon niger*, Kunth. Enum. i, 501.—*A. rubens*, Kunth l. c. 502.—*A. Sorghum*, subsp. *sativus*, var. *obovatus*, Hack. in Monogr. Androp. 514.—*A. Sorghum*, var. *bicolor*, Koern. in Bull. Herb. Boiss. ii, 226.

Description : An annual. Culms stout, up to 4 m. high, many-noded. Leaf-sheaths mostly overlapping, finely pubescent at the nodes ; ligules short, ciliate from the back ; blades linear to lanceolate-linear from a broad and rounded or slightly narrowed base, up to 50 cm. long and 7·5 cm. broad, pubescent to tomentose inside above the ligules and less so or glabrous on the back at the junction with the sheath. Panicles erect, contracted and more or less dense, or loose and oblong or oblong-ellipsoid or obovate to oblanceolate in outline 7·5-30 cm. by 5-9 cm. ; branches erect or obliquely erect, rather rigid, finally sometimes slightly drooping, the longest often more than half the length of the panicle and undivided for 12 mm. to 7·5 cm. from the base, like the branchlets very rough, spinulously ciliolate or ciliate, particularly upwards, silghtly hairy, rarely villous at the base. Racemes tough, compact, frequently 3- or 4- (rarely 5-) noded ; joints somewhat stout, flattened, 1·6-2·7 mm. long, shortly whitish or fulvously ciliate ; pedicels similar, about 1 mm. long. Sessile spikelet more or less broadly obovate even in flower, with very short broad and depressed tips, 4·8-5·8 mm. by 3·3-4·2 mm., straw-coloured to tawny, finally darker, often with red or brown or purple spots or blotches or turning altogether fuscous, chestnut-brown or quite black, closed when mature or only slightly gaping, usually awned ; callus-beard scanty. Involucral glumes equal, firmly coriaceous except at the papery to membranous tips, unevenly strigillose particularly and mostly persistently on the tips or almost glabrous ; lower up to 16-nerved, nerves very faint, keels short, usually obscure, tips very short, broadly triangular with a hyaline point, depressed ; upper broad, 9-nerved, obscurely keeled close to the tip, otherwise broadly rounded on the back. Floral glumes ciliate, lower broad-elliptic, about 4·2 mm. long, upper broad-ovate, 3·3 mm. long, 2-lobed, awn about 10·6 mm. long, sometimes much reduced. Anthers up to 4·2 mm. long. Grain tightly enclosed in the glumes or the top slightly exposed, obovate-oblong in outline, 3·3-3·8 mm. by 2-2·4 mm., brown ; embryo-mark distinct ; nerves obliterated. Pedicelled spikelet neuter, persistent, lanceolate to linear-oblong, acute, about 4·2 mm. long, reddish ; lower involucral glume 9-10-, upper about 7-nerved.

Distribution : Lower Guinea. Occasionally cultivated in the Mediterranean region from Madeira to India, also introduced into Australia, the West Indies and Brazil.

* 4. **Sorghum Durra**, Stapf in Fl. Trop. Afr. ix, 129.—*Holcus Durra*, Forsk. Fl. Aeg.-Arab. 174.—*H. Duna* (sphalm.), Gmelin Syst. 173.—*Andropogon Sorghum*, var. *aegyptiacus*, Koern. in Aschers. & Schweinf. Ill. Fl. Egypte 164—*A. Sorghum*, subsp. *sativus*, var. *Durra* and *aegyptiacus*, Hack. in Monogr. Androp. 516.—*A. Sorghum*, subsp. *sativus*, var. *Durra*, Chiov. in Ann. Istit. Bot. Roma, viii, 24.—*A. Sorghum*, var. *niloticus* and *Schweinfurthianus*, Koern. in Aschers. & Schweinf. l.c. 778, 779.—*A. Sorghum*, var. *arabicus* and *rubrocernuus*, Koern. in Bull. Herb. Boiss. ii, App. ii, 12 (*probabiliter.*)

Description : An annual. Culms stout, up to 4 m. high and even more, 20-40-noded. Leaf-sheaths finely pubescent at the nodes ; ligules very short, shortly ciliate ; blades up to 40 cm. by 5 cm., quite glabrous (? always). Panicle usually quite compact, ovoid or ellipsoid, erect or sometimes recurved, 10-15 cm.

by 5–10 cm. ; branches erect, more or less flexuous, rather slender, rough to spinulously ciliate, particularly upwards, ciliate to subvillous at the base, the longest up to one half or one-third the length of the panicle, divided from very low down. Racemes compact, tough, about 8·5 mm. long (in flower), mostly 3-or 4-noded ; joints somewhat stout, flattened, 1 to almost 2 mm. long, whitish-ciliate ; pedicels similar, but still shorter. Sessile spikelet rhombic-obovoid, subacute (in flower), greenish or straw-coloured with greenish tips, ultimately whitish or variously brown, dark red or black, awned or awnless, callus-beard scanty. Involucral glumes equal, coriaceous up to beyond ½ or ⅔, then papery, unevenly strigillose, particularly at the tips and sides ; lower with a broad triangular greenish strongly nerved tip, about 12-nerved with 3 or 4 finer nerves interspersed, 2-keeled upwards (keels rough), more or less flattened out and very broad to rotundate when mature with the tips worn off and the back glossy ; upper broad, 9-nerved with some additional finer nerves, slightly keeled upwards. Floral glumes ciliate ; lower ovate-elliptic, over 4·2 mm. long ; upper broad-ovate, 2-toothed, 4·2 mm. long, awn up to 7·5 mm. long, mostly much shorter and then hardly twisted and differentiated into column and bristle or quite suppressed. Anthers over 2 mm. long. Grain subglobose, slightly compressed, with a broad rounded much exposed top, white, yellow or variously reddish, 5·3 by 5·3 mm., nerveless, embryo-mark faint. Pedicelled spikelet neuter (? always), persistent ; lanceolate to linear-oblong, subacute, up to 6·3 mm. long, greenish or reddish, lower 11-, upper 7-nerved.

Distribution : Nileland of Tropical Africa, Arabia, Afghanistan, India.

*5. **Sorghum papyrascens,** Stapf in Fl. Trop. Afr. ix, 134.

Only mature panicles were known to Stapf. Culms up to 12 mm. across at the base of the panicle. Panicle erect, oblong to oblanceolate in outline, contracted, dense, up to over 30 cm. by 10–13 cm. ; branches more or less whorled, often many to a whorl, erect, the longer slightly arching, rather robust, like the branchlets rough to spinulously ciliolate upwards and softly ciliate or pubescent in addition, villous at the base or 12 mm. above it, following (longest) up to 15 cm. long and undivided for 5–7½ cm. from the base. Racemes tough, up to 4-noded and 18 mm. long, dense, much crowded ; joints moderately slender, up to over 3·3 mm. long, shortly white-ciliate ; pedicels similar, 1–2·7 mm. long. Sessile spikelet oblong (in flower), at length ovoid or oblong-ovoid, tight or somewhat inflated, closed, up to 9·5 mm. long, permanently pale straw-coloured or reddish ; callus-beard very short. Involucral glumes equal, papery and transparent throughout ; lower up to 16-nerved with numerous transverse veins, very obscurely keeled upwards or keelless, nerves raised from the base upwards, softly pubescent to almost villous, very imperfectly glabrescent or at length almost glabrous, hairs white ; upper broad, about 13-nerved, very obscurely keeled upwards, much less hairy. Floral glumes conspicuously ciliate ; lower broad-elliptic, 5·3 mm. long ; upper broad-ovate, entire and awnless or shortly 2-lobed, with a mucro or an awn up to 6·3 (rarely 10·6) mm. long, usually slightly bent and hardly twisted. Lodicules densely ciliate. Grain completely enclosed by the glumes or partly exposed by their breaking up, obovate to orbicular-obovate in outline, compressed, biconvex, dull white or orange ; embryo-mark faint, elliptic, slightly exceeding the middle of the grain. Pedicelled spikelet neuter, reduced to the involucral glumes, persistent, linear or linear-lanceolate, acute, pale straw-coloured or reddish, 6·3–8·5 mm. long, lower 11–13-, upper 9-nerved, shorter.

Distribution : Nileland of tropical Africa. Also known from India.

* 6. **Sorghum cernuum,** Host. Gram. Austr. iv, t. 3 ; Reichb. Ic. Fl. Germ. (1845.) t. 80, fig. 466 ; Stapf in Fl. Trop. Afr. ix, 136.—*Holcus Sorghum*, Linn. Sp. Pl. ed. 1, 1047 (*partim*) ; Mant. ii, 500.—*H. Dora*, Mieg. in Act. Helv. viii (1777), 125, t. 4, fig. 3.—*H. cernuus*, Ard. in Saggi sc. e lett. Acad. Padova i, 128, t. iii, fig. 1 and 2.—*H. compactus*, Lam. Encycl. iii, 140.—*Andropogon compactus*, Brot. Fl. Lus. i, 88.—*A. cernuus*, Roxb. Fl. Ind. i, 273.—*A. Sorghum* var. *cernuus*, Koern. in Koern. & Wern. Handb. Getreideb. i, 314.—*A. Sorghum* subsp. *sativus*, var. *cernuus*, Hack. in Monogr. Androp. 515.

Description : An annual. Culms stout, 3–4 m. high and more, 20–30-noded. Leaf-sheaths minutely pubescent at the nodes ; ligules very short, densely ciliate from the back ; blades linear-lanceolate, over 30 cm. by 6 cm., pale green, pubescent to tomentose inside above the ligule and outside at the junction with the sheath. Panicle erect or recurved, ovoid to oblong, very compact or somewhat loose, 10–25 cm. by 5–7·5 cm. ; branches rather stout below, rigid, spinulously ciliolate, particularly upwards, softly ciliate to villous at the base, branches divided almost from the base, the longest 5–7·5 cm. long. Racemes compact : up to 3- or 4-noded, up to 10·6 (rarely 12·7) mm. long ; joints stout, compressed, 1 mm. long, more or less white-silky-villous ; pedicels very similar, of about the same length. Sessile spikelet ovate with rather broad tips, 5·3 mm. by 3·3–3·8 mm., pale straw-coloured with greenish tips, whitish when mature, awned. Involucral glumes equal, coriaceous about up to the middle or at the base only, otherwise papery and often partly spongy, white-silky-villous all over or glabrous on the coriaceous portion of the back ; lower 12-nerved (with the nerves distinct upwards and sometimes with a few very delicate additional nerves interspersed), sharply 2-keeled upwards with the keels spinulously ciliolate and abruptly ending, forming minute teeth between which the hyaline end of the tip protrudes ; upper very broad, about 12-nerved, slightly keeled upwards. Floral glumes very densely ciliate ; lower broad-ovate, 2-lobed, 4·2 mm. long ; upper broad elliptic-oblong, awn about 8·5 mm. long with the bristle half the length of the long-exserted column or more or less reduced. Anthers 3·3 mm. long. Grain equalling the glumes or more or less exserted, orbicular or orbicular-obovate in outline, more or less compressed, 4·2–5·3 mm. by 4·2 mm., white, dull ; embryo-mark indistinct. Pedicelled spikelet neuter, linear-lanceolate, 4·2 mm. long, pubescent, lower involucral glume 11-, upper 10-nerved.

Distribution : Upper Guinea, North Central Tropical Africa, N. Africa, the Orient to Turkestan and N. India as far as Manipur.

(*To be continued*)

A SPORTING TRIP TO BRITISH SOMALILAND, 1926

BY

LIEUT. J. W. BORRADAILE

(With 6 plates)

A visitor to Somaliland, who is accustomed to shooting under Indian conditions, will find many differences and not the least among which is the non-existence of the 'block system'. If you are a resident of Aden, for the sum of Rs. 50 the whole country is open to you, while if you come from elsewhere the cost of a license is increased to Rs. 300.

In Somaliland you cover big distances and must be entirely self-contained as regards transport, provisions and water, once the main road which connects Berbera, Sheikh and Hargeisa is left behind, for it is possible to travel for many days without meeting a human being. Moreover there are only three serviceable rest houses in the country and these, including the new one at Berbera, are all situated on the main road. Shops are only to be found at Berbera, Sheikh, Burao and Hargeisa. On one occasion we sent a runner fifty miles for eggs and he returned with one !

Perhaps the greatest obstacle which the traveller has to face is the lack of water. The rainfall is more than sufficient, but as the soil is gravel all the water rapidly disappears and then can only be found at the regular water holes. Not only does this increase the caravan, but it limits the marches as a fresh water hole must be reached before the supply carried from the last one is finished.

The geography of Somaliland can be described broadly as follows :—From a coastal strip of desert the Golis and Asser Ranges rise step by step to a height of 5,000 ft. Thence the great waterless plateau, which is an eastern outcrop of the Abyssinian highland stretches inland, a waste of grasslands and thorn bush.

It was on July 3, 1926 and with the sun already low above the distant mountains, that I first sighted Berbera. It was a remarkable picture. An oasis of white houses and palm trees, around which the coastal desert appeared, deep gold against the blue and white of the sea.

It was already dark before we had taken all our possessions from the little Cowasjee steamer and been rowed ashore, so, as it was clearly impossible to continue the journey to Sheikh on that day, we occupied quarters in Berbera, which had kindly been set aside for us. A night in Berbera during the Kharif season is no joke and we hastened our preparations on the next day so as to be across the desert strip before this wind began to operate. From a local merchant we hired two ancient Ford busses into which we put our tents, bedding, cooking pots, water carriers, provisions, servants and finally ourselves. Much to our surprise these machines ploughed through the heavy sand at a reasonable speed, until about five miles outside Berbera we struck the foothills and the metalled road.

The foothills were bare and burnt-up and only at the regular halting places was there any sign of life, human or animal. To this statement I make one exception and that, about half-way between Berbera and Sheikh. Here my companion B— drew my attention to a small herd of gazelle which resembled the Chinkara of India. We recognized them as being Pelzehm's Gazelle, the Lowland Dhero of Somaliland, which are different from their highland relations the Speke's Gazelle in that the latter have very definite black markings on their sides and also a baggy protrusion on the nose which they can inflate to a great size. They do not do this under the influence of fear and I believe the cause is entirely sexual. In all other respects both these animals are the counterparts of the Arabian Gazelle and the Chinkara of India. As we expected to meet other representatives of this species we did not get out to shoot, but afterwards we discovered that they only inhabit the lower foothills and we only once came across them again.

After three hours we sighted the main bluff of the Golis Range which rises 2,000 feet sheer above a level stretch in the foothills and is the final 'step' up to the great plateau above. The road climbed a re-entrant in this bluff and after many bends and curves had been negotiated we could at last see the white houses of the little settlement of Sheikh across an open grassy plain.

It was at Sheikh that we were to engage our caravan, which would have been a lengthy business had not a kind friend already done most of the work for us. According to our reckoning we required ten camels at one rupee per march and four annas when stationary. We afterwards discovered that we had over-estimated the provisions required and could have managed with at least one camel less. These camels had three men and one woman with them as drivers.

We then engaged our hunters. B— had a Somali called Aden and a Midgan Jama, who had worked together very successfully on many previous trips. Aden spoke a little English and made an excellent foreman to the whole outfit, while Jama the Midgan as well as being an excellent hunter could speak and understand English, Arabic and Urdu, which he had acquired from the Pathan orderlies of a former master, as well as his own language. In addition he was something of a handy man and was by far the most useful servant we had.

These Midgans belong to an outcast tribe, whom the Somalis will not recognize. They depend for their livelihood on the use of their hunting dogs and are probably unequalled in the world as animal trackers. It would be interesting to see one of them following an animal with a Bhil of India over ground which was strange to both. The only times I have seen Indians trying to track seriously were, in one case tiger tracks a few hours old, and in the other those of a wounded panther which had passed a few minutes

1. The 'Motor Road' across the Maritime Desert.

By courtesy. *Capt. Ross Hurst.*

2. Golis Scenery.

3. View from Hol-ka-boba Pass, Golis Range.

4. Camp at Gobedieh.

before them. On each occasion they were painfully slow and lost the tracks as soon as they left the river bed.

I had a Somali chief hunter named Chama, who had experience of hunting in Nairobi, Abyssinia and the Sudan as well as his own country. My second hunter could understand no known language though I tried him in English, Urdu and Arabic, nor was he particularly adept at understanding signs, otherwise he was a good worker.

Having settled these two important items, it now remained to collect a cook boy and two boys who would act as assistant bearers and the choice of these was left entirely with our own servants. I must say that I have never been so well served as I was by these Somalis. Each one was more than ready to exceed his proper work both while out hunting and in camp. So, the camel drivers were often used as assistant hunters and the hunters would always give a hand in the work of the camp, so that the speed attained in pitching and striking camp and preparing meals was prodigious. With the exception of the camel drivers all the Somalis were rationed by us at the daily rate of 1 lb. of dates, 1 lb. of rice, and ¼ lb. of ghee. Also, of course, they always got their share of meat when there was sufficient.

On the advice of friends who had shot in Somaliland before, we had already mapped out a route and this was based on the localities in which the various animals were to be found : elephant and rhino are not on the Somali license. Of the great cats, lion and leopard follow the flocks of the nomadic Somal and can only be located in the first place by the reports of anyone who is met with on the road and their discovery is a matter of some difficulty. In the case of leopard the chances of news are further limited, because being vermin, the natives are allowed to shoot them and they can sell the skins for a handsome price. Cheetah on the other hand, not being molester of cattle, must be left entirely to chance.

Somaliland has a great variety of antelopes of which the king is the Greater Kudu, who grazes on the rocky hills of the Golis Range and rarely comes into the open plain. His cousin the Lesser Kudu lives on the aloe bush which is found in the foothills just below the main Golis bluff. Hargeisa District has been closed to both these species owing to rinderpest and when this protection is removed the great hunting ground for Kudu will be the Asser and not the Golis Range. The little antelopes, Klipspringer and Beira inhabit much the same country as the Greater Kudu. The Beira favours particularly some very stony flat-topped hills in the Asser Range.

Upland Dhero (Speke's Gazelle) and Aoul (Soemmering's Gazelle) inhabit the open grassy places of the plateau and are often found grazing together, while Lowland Dhero live entirely in the foothills. Gerenuk (Waller's Gazelle) are to be found in almost any bush country and are particularly addicted to country intersected by small hollows and nullahs. The largest heads belong to the foothills, the upland variety being shorter and thicker. Oryx and Swayne's Hartebeest inhabit the open stretches towards the Abyssinian border, though Hartebeest are now rare except in special localities. The Dib-a-Tag, a very rare beast lives in the surrounding bush and tall grass country, where also single male Oryx are found.

Finally the Dik-Dik, the smallest of antelopes are common to all bush country. Birds and hares and other exclusively 'pot' game keep to the neighbourhood of water and can usually be got within easy reach of camp.

Taking all this into consideration our plan was to travel along the top of the Golis as far as Hargeisa, picking up anything we could on the way. From Hargeisa we were to make a short journey into the waterless country of the plateau for Oryx and Hartebeest and then back along the foot of the Golis bluff for Greater and Lesser Kudu. Here also was the most likely country for lion and leopard.

The first march along the Golis was a short one in order to allow the caravan to settle down and except that we heard the sharp dog-like bark of baboons, the whole country seemed lifeless. We camped that night away from water eight miles outside Sheikh. We were off early in the morning and were at the watering place of Halo by midday, having collected one Klipspringer on the way. The Klipspringer is a pretty little beast standing about two feet at the shoulder with short straight horns and a very bristly coat. The Somalis call him Allacout and as we knew him only by his Dutch name there was some discussion before we identified him.

In this way we proceeded to the village of Adadleh, half-way between Sheikh and Hargeisa. A start was usually made at six in the morning and after the next meeting place with the caravan had been arranged, wet set out in different directions in search of game, usually taking the caravan route as a dividing line. From the stony hills around Halo we crossed the open plain and after this we struck the belt of bush round Adadleh, which we reached on the fifth day, having only collected the Klipspringer and three Dhero on the way. The country was uninhabited and we struck no encampments though we passed two or three caravans on the move, one of which gave us a false alarm of leopard which delayed us two hours.

This was my first experience of the African bush and I was struck immediately by the far greater variety of colouring and species than is seen in the Indian jungle. This was particularly noticeable in the case of birds and insects. Here were parrots, weaver birds, the great black and white horn-bill, the Kurria Plover with his white body and long red legs and painted starlings of every variety. One little fellow who reminded us of the Indian Myna was always round the camp. He had a gold breast and his wings were blue.

The Somalis have an ingenious scheme for catching birds alive. A succulent piece of corn is used as a bait and round this is concealed in the grass a wide slip knot. The bird descends and scratches for the corn, so tightening the knot round his leg.

There are three Somali insects, the memory of which will always be with me. The first are the huge centipedes which gave me many alarms until I was assured that they were harmless. The second are the ants which disfigure the landscape with their building operations, many of their houses standing ten feet above the ground. The third are the ticks which cling to the legs, above the puttees and a number of which must be removed after every march. Fortunately we were not visited by the hard tick who is a carrier of relapsing fever. In addition there were insects of every kind and colour.

At Adadlah, Gerenuk were plentiful but shy, and we spent the next two days chasing this giraffe-like beast, which with its ungainly trot, absurd neck and the forward curve of the horns, is absolutely unlike any of the other Somali antelopes. I had come to the end of an unsuccessful chase after a Gerenuk and it was almost dark, when I saw for the first time a striped hyena. In the failing light he looked such an imposing beast that I would have shot at him had not he had the luck to walk behind a tree and then, alarmed by our presence, glide silently away. It was at Adadleh too that B— had our only experience of Aardwolf (*Proteles cristatus,* Sparrm.) The name 'Earth Wolf' is deceptive as this animal is no wolf at all. He lives underground, is of a reddish-brown colour and stands about 18″ from the ground.

Before leaving Adadleh, we made two additions to the caravan. The first was one, Hasan, nicknamed the Waraba (Hyena) a waster and the ugliest man I have ever seen. He remained with us for the rest of the journey doing odd jobs for his keep and contented to receive no pay. He afterwards proved quite useful to us. The second addition was yet another baggage camel upon which I rode the rest of the way to Hargeisa as I had a slight sprain in the ankle. I was not sorry to say good-bye to this beast, for sitting on his back propped up by two tents for a mile was infinitely worse than walking two.

Beyond the bush country of Adadleh was the Goriale Plain, across which it took us two days to march. Here we made our first acquaintance with Aoul (*Gazella soemmeringi*), a beast of about the size of an Indian Black-buck, though much more heavily built and very slow and clumsy in his movements. The horns of the Aoul curve inwards at the top and sometimes measure 20″. B— came back to camp with one on the first day and on the second I spied from the top of my camel a fat old Aoul grazing with two Dhero does. I dismounted and approached him at a somewhat deliberate pace and he watched me quite unmoved. When we afterwards measured his horns we found them to be 17½″.

On the same day B— brought back two Goli Warabas or Black-eared foxes. These beasts had always been something of a mystery to us. When my ankle had first given trouble at Adadleh, I had amused myself in the evenings by sitting up over a piece of meat at sundown in the hope of shooting one. I only succeeded in getting two jackals, which the Somalis call 'Fockus' and it was the mention of this name that had made me expect to see Black-eared fox. In the end I was told that Goli Warabas do not eat meat, which surprised me as they certainly have the head and teeth of the fox. Another peculiar thing we noticed about the Goli Waraba was that the plateau variety seem to be a different breed to those in the foothills, and in spite of the hotter climate the latter have the heavier coats.

We were now in bush country again near the watering place of Badalwanak. Our next march should have brought us to Hargeisa had we not been the victims of a most peculiar occurrence. It had been raining during the morning in the hills which flanked our route and we were proceeding cheerfully with the caravan under the perfect blue sky, when we noticed that the ground underfoot was becoming sodden and in a few minutes the country was changed from a hard sandy surface into a marsh. Of course the camels could not proceed so we had to spend the night on the nearest high ground. In the morning it was dry enough to march into Hargeisa which we reached before midday.

Hargeisa is the serai of the Abyssinian trading caravans. It has a small English population which at that time included the District Commissioner, the Medical Officer, the Police Officer and the Headquarters of one company of the Camel Corps. Here we spent two days in order to replenish stores and make preparations for the journey to the Seila Ban Plain. We were able to borrow six more water tanks which with the two we already carried gave us a total of one hundred and twenty gallons.

We cut down the number of our followers by two, but added one man with local knowledge who was to act as a guide, also I exchanged my camel for a country pony and though the necessity of taking him was a drain on our resources, these ponies can work on very little moisture and are far more manageable than a baggage camel. At Hargeisa I was given the opportunity of playing a game of polo on them. I ride 13 stone 4 lbs., but they can carry heavier men than I with the greatest ease and turn remarkably quickly.

The road to the Seila Ban Plain took us through thorn bush and fields of yellow and red orchids. On the first day we reached camp in a storm which, though unpleasant at the time, gave us three hours of rain and filled water holes which would ordinarily have been dry. This to some extent solved our water problem, as the pony could be led to water and the used tanks could be refilled. The Somalis are notoriously lavish with water and even when the strictest guard is kept over it will aways find a way to waste some, which, considering the conditions they have always had to face it is surprising.

We were out early on the second day in search of Oryx and after about an hour's walk I struck a large Somali Karria (encampment) where I waited while my hunters asked for news.

These encampments are completely surrounded by a fence of bushes called a Zareba and inside are similarly divided into pens for sheep and cattle, two or three main roads and a space of about four yards round the circumference into which the camels are led at night.

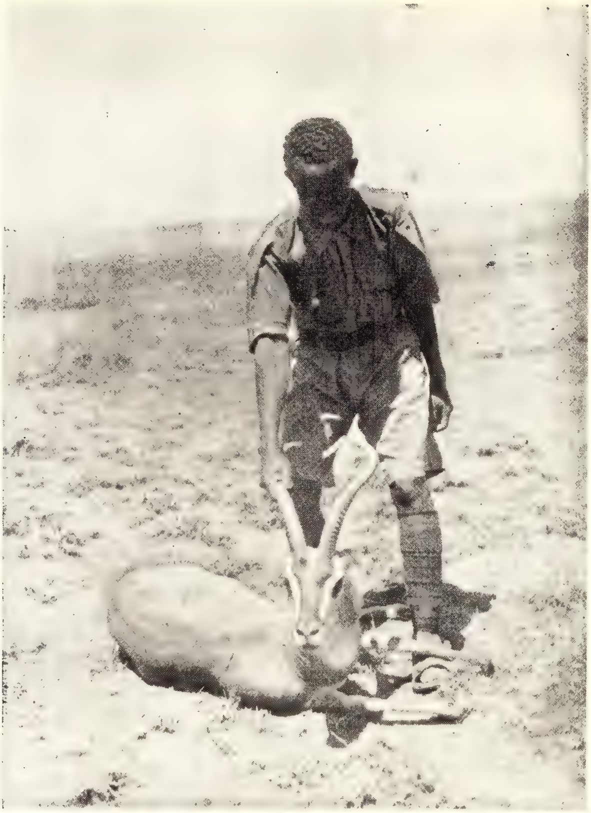
These can be erected in a very short time with the aid of short sticks crooked at one end and forked at the other.

The crook is used for pulling the bushes up and the fork for

5. A *Kurria* WATERING, ALLADIEH.

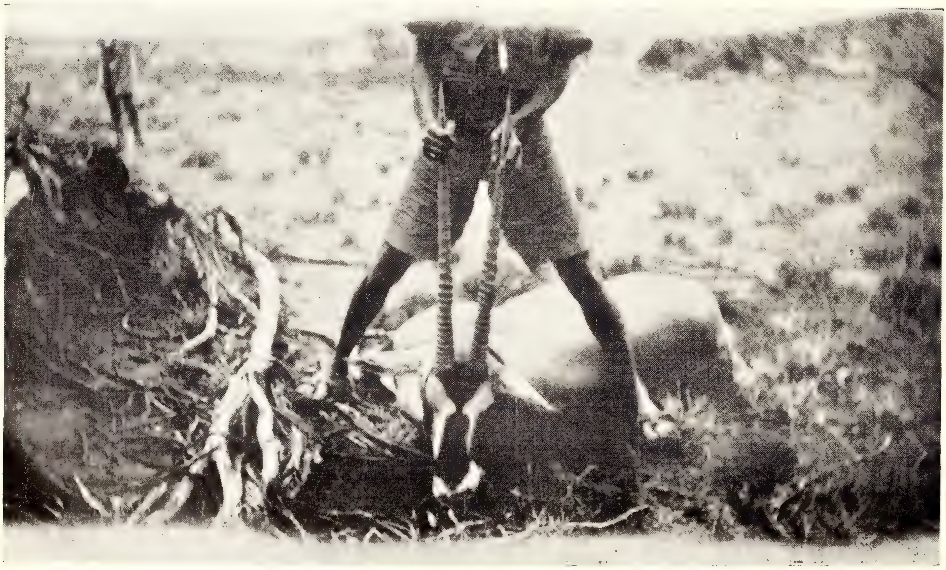
By courtesy Capt. Ross Hurst.

6. LESSER KUDU (*Strepsiceros imberbis*, Bly.)



By courtesy *Capt. Ross Hurst*

7. 'AOUL' OR SOEMMERING'S GAZELLE (*Gazella soemmeringi*, CRETSCHM.)



8. ORYX (*Oryx beisa*, RUPP.)

pushing them into position. When the tribe leaves the neighbourhood the old camp is left standing and these are to be seen all over Somaliland.

At this encampment I had my first drink of camel's milk out of a wooden bowl. I found it creamy and most nourishing. I also photographed a Somali woman carrying a child slung in a cloth on her back. The Somalis both women and men are usually of good physique and are often remarkably handsome, of which fact they are well aware, for a vainer race it would be hard to imagine. They are clean, and at intervals of about a week the men wash their hair with a sort of yellow plaster. Their dress consists of a sheet and they generally go bareheaded. Nearly everyone met with on the road carries arms, either an antiquated rifle or a couple of spears or club with an Oryx-hide shield. They are great fighters and will always join in anyone's squabble if they think they can get a good fight out of it.

Soon after leaving the encampment which caused this diversion, we found fresh Oryx tracks and within an hour I had got a fine male Oryx. The Oryx stands about the same height as a bull, has massive shoulders, is grey in colour with very noticeable black markings on the face. His cumbrous bovine appearance gives one the impression of great strength and endurance while his horns are straight and business-like.

It was late in the afternoon before B— reached camp and he told me he had followed the same Oryx tracks as I, and that seeing our footmarks had changed his direction. After an uneventful morning he had decided to make for camp and when he had tramped steadily for some way he thought he recognized a water pool which he had seen before, he marked this with his stick. Within an hour he was back at the same pool again. It was a dull day so he did not have the sun to help him. However he struck out in what he thought to be the right direction and it was many hours before he found a wandering Somali who guided him back to camp without hesitating once on the way.

The Somali bush on a dull day is most dangerous as it is completely featureless, the field of view is rarely more than a hundred yards and above all it is waterless. There are many cases on record of novices being 'bushed', but that this should happen to two Somali hunters conducting an Englishman surprised us.

Our next march led us to the edge of the plain. We made our camp (round which we built a complete Zareba) some two miles inside the bush in order to get shelter from the Kharif wind and a very charming little camp it was too. Here above all other places we felt entirely cut off from the human race with nothing but the bush and plain with their wild inmates around us.

It was on this day that I crawled up behind a bush to within twenty yards of an Oryx who was taking his afternoon siesta. I was so startled by his magnificent appearance at this close range, that I quite forgot to shoot and I watched him scramble ponderously to his feet and away !

The story of my second Oryx is not creditable. I wounded the animal rather too far forward and in our anxiety not to lose sight of him again, we followed him as fast as we could run. After a disgraceful fusilade I brought him down and then feeling in the pocket of my woollen waistcoat for more ammunition was horrified to discover that it had dropped out and my stupid second hunter, who was following, had not retrieved it, so there I was with a wounded Oryx on my hands and not a round of ammunition within five miles. After a fruitless search for the ammunition we went up to have a look at the Oryx. He was quite alive but could not move. At last we resorted to a desperate remedy, placing a log of wood between his horns we twisted them until his neck was in a suitable position for the *halal* and though we accomplished this in the end he gave the three of us all we could manage and I learnt my lesson never to carry all my ammunition in one pocket.

Perhaps the best day of all was the one spent on the plain itself. There with an uninterrupted field of view of something like twenty miles, we could see great herds of Aoul probably totalling over 3,000 grazing beside herds of Oryx and far away to the south was the thin black line of the bush country on the Abyssinian border. We were disappointed at the absence of Hartebeeste and though B— got to within 300 yards of a male Ostrich the wind was too high to fire at anything but a certainty. Directly he became aware of our presence he made off at a great speed, dodging from side to side and looking like a bush on stilts. Here too B— saw a baby Aoul being chased by a hunting dog. The dog, by good stalking had got up wind of him and the little Aoul only just reached his family in time.

Having shot our allowance just as the water was running short, we returned to Hargeisa. Oryx meat is a great delicacy for the Somalis and the total amount of meat brought back to camp during this week must have been 400 lbs., yet when we asked for Oryx meat again in Hargeisa we were told that the Sahibs had eaten it all !

On our second visit to Hargeisa we were given the privilege of attending the court and were struck by the number of trivial matters which were brought up. One man complained that his son aged fifteen had been stealing the milk, another that his brother had hit him over the head with a club. All this goes to show that the Somali prefers British arbitration to his own methods.

Somaliland being a Protectorate is governed by Somali law, not British. Somali law has the peculiarity that capital punishment does not exist. The penalty for manslaughter, whether accidental or not, is the presentation of one hundred camels from the tribe of the offender to the tribe of the victim. This queer survival of inter-tribal law would have meant that had I accidentally killed a hunter, I should have been fined one hundred camels or 3,000 rupees.

We were now in two minds whether to strike west from Hargeisa as far as the Abyssinian border in hope of getting Hartebeeste or reserve the whole of our remaining time for the Guban route, below the Golis bluff. Circumstances led us to take a middle course which we bitterly regretted. This course was to strike north-west from Hargeisa to a place called Ged-ka-Debkaleh, where we had heard that there were leopard, and thence join the Guban route at the foot of the Asser Hills. At Ged-ka-Debkaleh we found a huge fig tree which covered our whole camp. Of course there were no leopard there, so having disposed of the last Gerenuk on our license, we had to content ourselves with shooting Dik-Dik and game birds for the pot.

These did not fail us and we collected quite a number of species including Quail, Ball-throated Francolin, Partridge and Lesser Bustard and though we saw Greater Bustard and Guinea Fowl the moment was never opportune for shooting them. The Dik-Dik is a tiny antelope not larger than a hare, but he has a beautiful soft coat which is much in demand for ladies' gloves.

We now had a march of over thirty miles across waterless country to reach Jalelo on the main Guban route and as we had no man who had been this way before, Hasan, the Waraba, was taken on the strength in the capacity of guide. The direction of Jalelo was nearly due east and on the first day he took us north. Luckily we found water and camped by it for the night. We were taking our usual evening walk in search of birds when we encountered a large male Wart Hog, who appeared to be eyeing us in an aggressive manner, in fact he even advanced towards us. We had only one shot gun between us and B— slipped a round of lethel into it and fired. The ball went over his head, and the Wart Hog turned and trotted slowly away keeping his tail erect and completely unconcerned. I afterwards shot one of these beasts who behaved in exactly the same way. I do not think they do this with any idea of attacking a man, but standing in no particular awe of him, as they are absolutely safe from the Somalis, they approach merely to satisfy their curiosity. They differ from the Indian boar in that their long tusks are the upper and not the lower ones. I could never imagine one of them attacking the line of beaters and horses unprovoked, as I have seen an Indian boar do and I think the country in which they are found would make it impossible to hunt them on horseback.

We started at 6 a.m. on the next day and Hasan, the Waraba, completely led us astray. He could march in no particular direction for any time and at last we had to take control and set a course by the sun and we did not reach Jalelo until seven in the evening.

This was the second time that our hunters had lost us and yet in country which they know they can guide you back to camp in the most infallible manner. I can only think that they do not guide themselves as we do by sense of direction and the position of the sun, but from long experience have learnt to remember features in the bush which escape us altogether.

After this march we decided to have a day of rest at Jalelo. In the evening it began to thunder and rain, so we had dinner in our tents. Presently we heard the roar of water outside and ran out to see by the flashes of lightning that the river bed was a raging torrent some 300 yards wide. It must have risen eight feet in a few minutes. Soon the water covered our feet, then coming in from another direction put out the fires and swept into the tents. Boots and boxes of provisions were floating about everywhere, A trap of branches was quickly made, the tents were struck and everything was carried up the hill. Only one person remained quite unmoved during the whole proceeding and that was the cook boy, who, sitting on a slight eminence, continued to bake to-morrow's bread until the flood had subsided from around him.

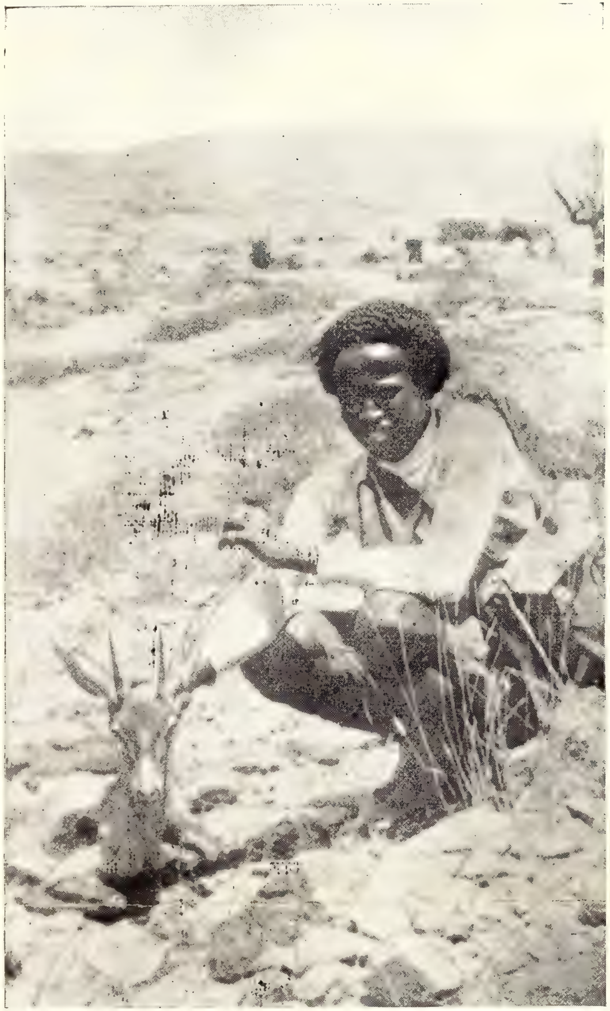
The spate had not sufficiently subsided by the morning to allow us to move and it was not until the third morning after our arrival at Jalelo that we started our next march to Argan. After the spate the servants took the opportunity of asking for a rupee each 'to give to the Bishop at the coffee shop' as a thanksgiving for their deliverance. Needless to say this was not granted. The Somali coffee shop is not as its name signifies, a place where coffee may be bought, but it is usually a rickety house of branches near a water hole where those who come to draw water from the neighbouring Karrias, may sit down and exchange news.

We had not proceeded far on the Argan road before we saw leopard tracks in a river bed, so decided to camp the night by some water, which was nearby and in the meantime to send out men in all directions for news. We heard that the leopard had visited a Karria about three miles away and we reached this place before dark.

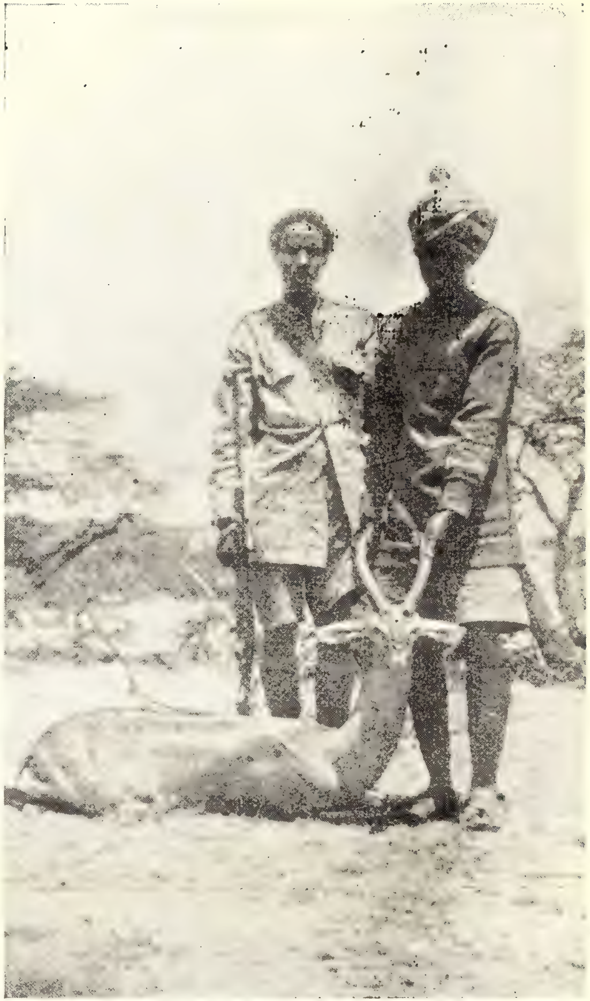
The Somali method of shooting leopard is to tie up a goat outside the Zareba at night with a rifle hole within two yards of him. The leopard attracted by his cries pounces on the goat right under the muzzle of the rifle. Only of course it is not nearly so simple as all that. For one thing the leopard are wily and will smell a rat if there is any flaw in the preparations, and for another thing the hyenas are a perfect plague and must be driven off silently by the hunter with a spear. Added to this, on a dark night, it is not easy to distinguish through a small hole with the eye, a rifle's length behind, which is a leopard and which a hyena. On this occasion the hyenas were particularly numerous and no leopard appeared and although we laid this trap several times during the return journey it was never successful.

Argan is an attractive spot. The banks of the river bed are covered with bullrushes and date bushes. Here I tried to photograph some baboons, but they seemed so annoyed at my intrusion that I took the exposure at too long a range and the result was unsatisfactory. Another peculiar little beast which we saw here was the Rock Rabbit. He appeared to be about the size of a rabbit without the long ears and this made his head seem very round.

At Argan we got rumours of lion and again sent our hunters out into the country for news. Hasan, the Waraba, returned to say that he had seen the tracks of a female and two cubs five days old at a pool some way up stream and we set out in this direction on the next morning. We soon found tracks of the previous evening and followed them through the most forbidding looking rocky outcrops of the hills. Unfortunately the lady had not killed during the night, so she did not lie up anywhere; at one point we saw the marks of her having attacked a Wart Hog. There had been a scuffle, but the Wart Hog had undoubtedly made



9. Juma the Midgan with 'Beira' (*Dorcatragus melanotis* Menges).



10. 'Gerenuk' or Waller's Gazelle (*Lithocranius walleri*, Brooke).

11. The Golis Range

12. The Village of Adadleh.

his escape. It was not until after dark that we reached camp to hear that a male lion had killed a camel five miles away in the opposite direction and that the news had come in too late to reach us.

The difference in the tactics used on the Somali lion and the Indian tiger are great. There is no question of sitting up in a machaan after dark as the lion rarely returns to his kill, though he is sometimes caught by the same trap as is used for leopard. In Somaliland also the only beaters available are drawn from your own personnel and rarely number more than five. Usually the lion is tracked to wherever he is sleeping off the effects of his feed and if the bush is thick you manœuvre to get down wind while the hunters fire the grass on the opposite side and he must be shot on foot as he emerges, there being no tree capable of holding a machaan.

The next morning we were out at the pool again, but saw no new tracks. Attracted by the gathering of vultures we visited a Karria to find that a camel had died from natural causes and that the Somalis were eating the flesh almost hot off the beast. Leaving this rather unpleasant scene, we crossed a col into another valley and here B— shot a Beira with a head of 4½″. The Beira (*Dorcatragus melanotis*) is rather bigger than a Klipspringer. His French grey colour makes him very difficult to pick out on the hillside. His ears are huge and in proportion to his body and his feet are rounded at the bottom in a peculiar manner.

As our time was now getting short, we had to leave Argan behind us and start the next march to Mandera. At this place we had our first dealings with Lesser Kudu, which lives in the very thick bush just below the Golis bluff. Like the Beira he has huge ears and when disturbed bolts away at a great speed, making it very difficult to shoot him.

My two hunters were once following the tracks of a Lesser Kudu and I was walking behind them, when I suddenly saw the head and neck of the Lesser Kudu above a bush a few yards away. He was watching the movements of the hunters with the greatest interest and they had walked right past him. Directly he saw that he was detected he made off like a streak. Between Sheikh and Mandera we each got our allowance of Lesser Kudu, but not without many failures. He is a beautiful antelope with his spiral horns and striped body and is well worth the trouble and expenditure of shirts torn by the very thorny bush.

On the hills above Mandera I chased a fine Greater Kudu bull for eleven hours on one day and twelve on the next and only got three glimpses of him. On the last occasion I determined to fire at any reasonable range. I got one at 300 yards with a cross wind and only scratched him on the back of the leg and though I followed him all that day, I failed to come up with him again, but as he climbed three large hills, I hope he is alive to this day. The specimen I afterwards shot not far from Sheikh was not to be compared with this one.

On the way to Lower Sheikh we passed mica deposits in the hills and took seeds of various plants including sweet peas and castor-oil plant. Our hunters collected honey. There we paid off our followers. The whole cost of two months was about Rs. 1,200 each and this included liberal tips. Most of the provisions which we took were unused and we only opened two tins of sausages during the whole period and that was when we were following lion at Argan. Our bag included one Great Kudu, four Lesser Kudu, one Beira, two Klipspringer, four Oryx, four Aoul, six Gerenuk, five Speke's Gazelle, one Pelzehm's Gazelle, fifteen Dik-Dik, one Wart Hog, three Black-eared Fox and with game birds and hares numbered about 112 head.

We were preparing for our departure at Berbera when we were surprised to see Hasan the Waraba whom we had left at Sheikh, the possessor of only a waist band and a talisman. He was now dressed in a brand new sheet, the ample folds of which covered his whole body and round his waist was tied a coloured cloth.

INDIAN DRAGONFLIES

BY

LT.-COL. F. C. FRASER, I.M.S., F.E.S.

Part XXVIII

(*With three plates.*)

(*Continued from page 889 of Vol. XXXI*)

Genus—RHINOCYPHA Ramb. *cont.*

Rhinocypha ignipennis, Selys, Bull. Acad. Belg. (2) xlvii. p. (1879) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 173, 179–181 (1904) ; Laid, Rec. Ind. Mus. p. 35, vol. xiii (1917) ; Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 22 mm. Hindwing 22 mm.

Head. Labium black ; labrum black, unmarked in adults, with two oval bluish spots in tenerals ; face glossy black, upper part of head velvety black with a small oval orange spot on the outer side of each posterior ocellus and a small rounded postocular spot on each side of occiput. At rear of latter, and midway between these two spots, a small linear orange spot.

Prothorax velvety black with a small median orange spot on the hinder part of median lobe and a long lateral spot of pale blue or yellowish on each side.

Thorax velvety black marked with orange as follows :—a tiny upper antehumeral spot, a fine linear posthumeral stripe broadly broken above, incomplete below, a short linear spot on the upper part of the first lateral suture, and an elongate oblique lateral orange stripe on the lower part of thorax, broadly broken in two by the anterior border of metepimeron.

Legs black, the hinder pairs of tibiae not pulverulent on the inner side as in most other species.

Wings semiopaque from node to apices, this area dark brown by transmitted light, brilliant fiery coppery by reflected light. The hinder pair with two rows of vitreous spots which vary in tint from mother-of-pearl to palest peach-blossom pink or pale blue. The most basal spot about 14 cells long, one cell-row wide, begins about six cells proximal to the node and ends distad about two to four postnodal cells beyond the node, lying between *MA* and *Riv* + *v*.

The outer row consisting of three long stripes similarly coloured, the costal one rather the longest of the three, the posterior slightly the shortest, the costal one lying between *IRii* and *Riii*, about 26 cells long ; the middle stripe between the same nervures as the basal spot, about 22 cells long, one cell wide proximad, three distad ; the hinder stripe 15 cells long, lying between *Cui*, and *MA*.

Pterostigma dark yellowish brown framed in black and with inner third the same colour. Inner hyaline areas of wings tinted with pale yellow ; 16 to 18 antenodal nervures ; discoidal cells traversed 3 to 4 times ; petiolation begins rather nearer the level of the proximal antenodal than the level of arc.

Abdomen black or steely blue, marked on the sides of the first two segments only, with a large orange spot on segment 1 and a tiny apical spot on segment 2. Teneral specimens are marked very nearly as in the female described below.

Anal appendages black, shaped as for *cuneata*.

Female. Abdomen 21 mm. Hindwing 28 mm.

Head black spotted with yellow or orange as follows :—The base of the labium and a spot on each lateral lobe, a broad oval spot on each side the base of labrum, the mandibles broadly, a large spot on each cheek and the basal joints of antennae, a tiny spot on each side of epistome, a large broadly oval transverse spot on each side of frons, with a smaller spot just behind each, a rounded spot on each side of the anterior ocellus and lastly the same spots as in the male

Prothorax black with bright yellow markings as follows :—A fine medial middorsal line running from the posterior lobe to anterior end, the marginal crest of the posterior lobe and an inward prolongation from this, a very large bell-shaped spot on the sides of the middle lobe.

Thorax velvety black, marked as for the male but more broadly so, the oblique lateral stripe extending the whole length of thorax, and broken in three places by the lateral and humeral sutures.

The humeral spot linear and, after a short interval, continued as a fine stripe to anterior end of thorax; the posthumeral stripe complete. Beneath, two large orange spots at hinder area of thorax.

Legs black, the flexor surfaces of femora slightly but distinctly pulverulent.

The middorsal carina and midline of antealar sinus finely yellow.

Wings hyaline, palely enfumed greenish yellow. Pterostigma as for male; antenodal nervures about 20 in number.

Abdomen black marked with yellow or ochreous as follows :—Segment 1 with a large lateral spot, 2 to 4 with an apico-lateral spot and a linear spot nearly confluent with it, lengthening to a stripe on segments 3 and 4; lastly segments 5 and 6 with a vestigial apicolateral spot. Anal appendages and vulvar scale as for *cuneata*.

Distribution. Assam and Upper Burma. Mr. T. Bainbrigge Fletcher has found it quite common at Shillong, Assam during September to November. The Selysian type comes from this district, and is now in the Brussels Museum. The specimen described by Williamson from Burma is undoubtedly a teneral male of this species, and is the only record from Burma.

The species is quite easily distinguished from all others save *trimaculata* which has the same glorious colouring, but which is smaller and has the vitreous spots much shorter than in *ignipenuis*. *R. fulgipennis* from Siam has similarly coloured wings, but the wings are broader and the thorax bears a coloured mesothoracic triangle. The colouring of the wings of these three handsome insects reminds one strongly of the gorgeous fiery Indian sunsets and is unexampled in nature.

Rhinocypha trimaculata, Selys, Syn. Cal. p. 62 (1853); Id. Mon. Calop. p. 211 (1854); Laid. Rec. Ind. Mus., vol. xiii, p. 35 (1917); Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 18 mm. Hindwing 22 mm.

Head velvety black, labium and labrum unmarked, vertex and occiput marked as for *ignipennis*, viz.,—a reniform spot on the outer side of each hinder ocellus and a small round postocular spot behind each, with an elongate small spot between them on hinder border of occiput.

Prothorax velvety black, quite unmarked.

Thorax glossy black marked with bright yellow, bluish green or blue according to the age of specimen, as follows :—A tiny upper humeral spot, a fine linear posthumeral stripe, broken above, a short fine line on upper part of first lateral suture, an irregular oblique stripe running the full length of side of thorax, broken into three spots, one of which occupies the central part of metepimeron, and another, more elongate, the centre of mesepimeron.

Legs black, not pulvurulent as to the tibiae.

Wings fiery coppery red, even more brilliant than in *ignipennis*, semiopaque from level of node in hindwings, from slightly distad of that level in the fore where the costal margin of wing is hyaline as far as beyond the pterostigma. In the hindwing four vitreous spots of the palest iridescent blue or peach-blossom pink, the palest one of which is about 17 cells long, extends from distal end of discoidal call to the level of the 3rd postnodal cell, and lies between *MA* and *Riv + v*. The outer spots consist of a series of three, all of about the same length, the costal one lying between *IRii* and *Riii* and about 13 cells long, the medial and hinder spots each 10 cells long, the latter lying between *Cuii* and *MA*.

Pterostigma blackish brown, clouded with white in its outer half in subadults. Antenodal nervures 15 to 17 in number; discoidal cell traversed 2 or 3 times.

Abdomen glossy black with a lateral spical spot on segments 1 and 2.

Anal appendages black, shaped as for genus.

Female. Abdomen 17 mm. Hindwing 23 mm.

Head velvety black marked with pale yellow as follows :—The base of labium, which has a greenish tinge, a pair of small basal spots on labrum, the bases of mandibles broadly, large darker yellow spot on upper surface of rhinarium and two large cuneiform spots just behind it. The basal segments of antennae, a rounded spot in front and on either side of the anterior ocellus, a small spot on either side of rhinarium and finally the same spots as seen in the male.

Prothorax black with a large yellow spot on each side of midlobe, a short medial dorsal line on the posterior lobe and a large spot on each side, low down near the trochanters.

Thorax black marked with yellow as follows :—Similar but larger spots as seen in the male, often with a greenish tinge, and probably bluish during life. In addition, a long linear streak on lower half of humeral region. Beneath thorax two broad longitudinal streaks of greenish yellow. Legs, black, non-pruinescent.

Wings deeply enfumed, burnt brown, especially the hinder and towards the apices. Pterostigma black, white in its outer half ; 12 antenodal nervures ; discoidal cells traversed twice in all wings.

Abdomen black marked with blue, the first seven segments with a lateral apical spot, the 2nd to 5th with a lateral stripe in line with but not confluent with the apical spots.

Anal appendages and vulvar scale black, shaped as for the genus.

Distribution. The Selysian types, two males, are reported as from Thibet. The species, discovered in 1853, was not found again until Mr. Antrim took it in numbers at Cachar, Assam in September 1921. It must be a remarkably local insect or such a handsome, and brilliant insect would have been taken many times in the intervening 68 years. If possible, its brilliancy outshines its near relation *ignipennis*, from which it is distinguished by its smaller size and the vitreous spots of hindwing much shorter. The female, hitherto, unknown, and described here for the first time, is also distinguished by its smaller size and by its blue markings, etc.

Paratypes have been placed in the British Museum.

Rhinocypha unimaculata, Selys. Syn. Cal. p. 61 (1853) ; Id. Mon. Cal. p. 207 (1854) ; Walk., (*Libellago unimaculata*) List. Neur. Ins. B. M. iv. p. 649, n. 12 (1853) ; Laid. Rec. Ind. Mus., vol. xiii, p. 35 (1917) ; Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 24 mm. Hindwing 27–30 mm.

Head velvety black, the labium and labrum unmarked, rounded spots of chrone yellow on each side of occiput, one on the outer side of each hinder ocellus and a central spot on posterior border of occiput.

Prothorax black with a large irregular yellow spot on each side of middle lobe, a small linear middorsal spot on the posterior lobe and a narrow yellow margin to the same lobe laterally.

Thorax glossy black marked with bright yellow lines as follows :—A short oblique linear upper humeral spot, a long antehumeral line, incomplete above, markedly angulate below, a fine posthumeral line broken above, a short upper line on the first lateral suture and finally the same broad broken oblique stripe on lower part of sides of thorax as seen in *ignipennis* and *trimaculata*. The middorsal carina is usually finely mapped out in yellow, and this may be continued on to the antealar sinus.

Legs black, the two hinder pairs of femora and tibiæ densely pruinosed white with a creamy yellow tinge.

Wings enfumed brown from slightly distad the level of node in forewings, and slightly proximad the same level in the hind, where this area is prolonged as a diffuse tongue in the space between *IRiii* and *Riv* + *v*. This area is also considerably darker in the hindwings, and in both pairs, is of a similar brilliant fiery coppery red as seen in *ignipennis* and *trimaculata*. In the hindwings, the middle of this coppery area bears a large roughly quadrate vitreous spot which glows emerald green or peacock blue according to the angle from which viewed. Its inner border is markedly indented, its outer roughly convex, its costal border is bounded by *Rii*, its posterior almost reaches the wing margin. The spot lies considerably nearer the node than pterostigma. Bases of wings hyaline, palely tinted with yellow. Pterostigma blackish brown, the outer halves paler. The apices of wings very finely reticulated, especially between the costa and *Ri*. Discoidal cells traversed from 5 to 7 times ; 21 to 23 antenodal nervures.

Abdomen black marked with yellow as follows :—The first 6 segments with a ventral stripe running nearly the full length of segments, segments 1 to 3 with an apical lateral spot, the intersegmental nodes narrowly yellow.

Anal appendages black, relatively short, shaped as for genus.

Female. Abdomen 22 mm. Hindwing 31-32 mm.

Markings of body very similar to those of male but more extensive.

Head with the same spots as in the male, with the addition of the following :— The lateral lobes of the labium, two obscure basal spots on labrum, the bases of mandibles broadly, this colour here confluent with a stripe which runs up the cheeks adjacent to and bordering the eyes, also extending on to basal joints of antennæ, and confluent with two large cuneiform spots on upper surface of rhinarium. On the latter, in front above, a large rounded spot; a round spot on each side of and in front of the anterior ocellus, two tiny points between the posterior ocelli and a spot on the lower part of the sides of rhinarium. The postocular spots are much larger than in the male, and are nearly united by a transverse spot on hinder border of occiput.

Prothorax black marked similarly to the male but the middorsal stripe runs nearly the whole length of dorsum from hinder border of posterior lobe, and the lateral markings are much better defined.

Thorax glossy black marked as in the male but considerably more extensive. The antehumeral line continued up and curved outwards above to become confluent with the humeral oblique spot. Six small spots beneath thorax. Legs black, the hind two pairs of femora and tibiæ pruinosed yellow as in the male.

Abdomen glossy black marked with two parallel stripes of yellow, one ventral as in the male, extending from segment 1 to 7, the other on the same segments becoming broken up into a stripe and an apical spot on segments 4 to 7. Anal appendages and vulvar scale as for genus. The middorsal carina finely yellow from segment 2 to 7.

Distribution. The species seems to be centred about Darjeeling and is colonized in several districts in northern Bengal and Assam. The type is in the Selysian collection at Brussels, without locality save 'India.' It is the largest species of the genus and distinguished very readily by its peculiarly striking combination of markings and colours. By the absence of the mesothoracic triangle and the coppery colours of the wings it is closely related to the two foregoing species. A fusion of the middle series of vitreous spots has resulted in the large median spot, thus in one of my own specimens, the spot is practically cut in two by an invasion of the dark area above. I have taken this species in May and June, perching on rocks in midstream at Mongpoo, 3600 ft. British Sikhim.

Rhinocypha bifasciata, Selys, Bull. Acad. Belg. (2) xlviii, p. 386 (1879); Laid. Rec. Ind. Mus., vol. xiii, p. 34 (1897); Kirby. Cat. Odon. p. 113 (1890).

Male. Abdomen 22 mm. Hindwing 25 mm.

Head glossy black in front, velvety black above, labium and labrum unmarked, a large oval spot on the outer side of each posterior ocellus and a small round postocular spot on each side of the occiput.

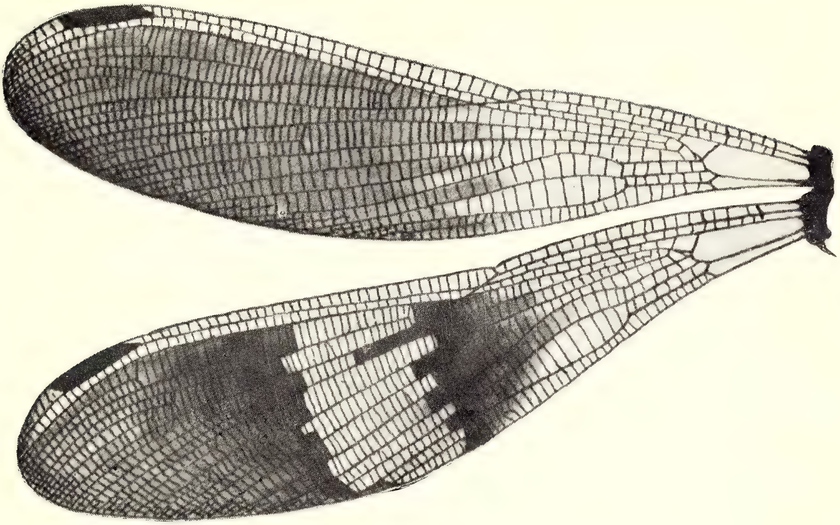
Prothorax black with a middorsal longitudinal spot on the posterior lobe.

Legs black, the two hinder pairs of femora and tibiæ heavily pruinosed white, this snow-like excrescense overlapping the margins of tibiæ and making them appear to be dilated.

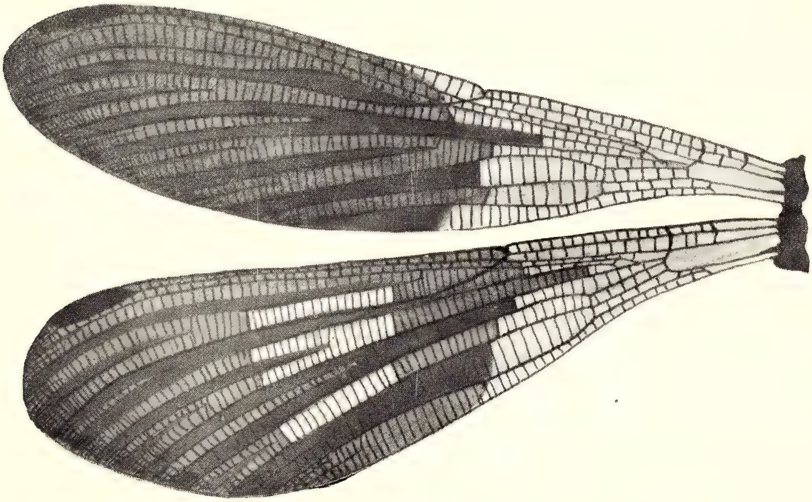
Thorax glossy black marked on the sides with a broad broken yellow band made up of a small serrate spot on the metepimeron, an elongate pyriform spot on the mesepimeron capped by a U-shaped spot anteriorly. The mesothoracic triangle very large, extending from alar sinus to anterior border of thorax, palest azure blue in colour.

Wings partially hyaline, greyish from discoidal cell to apex by transmitted light, palely yellow at the base. The darkened area by reflected light a beautiful violety blue or emerald green according to the angle from which viewed. The wings in this area have a satiny gloss and the hind are traversed by two brown bands from costa to hinder border, one at the apex of hind wings and the other a short distance to the inner side of pterostigma. Both bands very narrow and the inner very irregular and diverse in shape. The iridescent area limited anteriorly by *Rii*. Discoidal cells traversed 5 times; 15 to 18 antenodal nervures. Pterostigma black, white or yellowish outwardly.

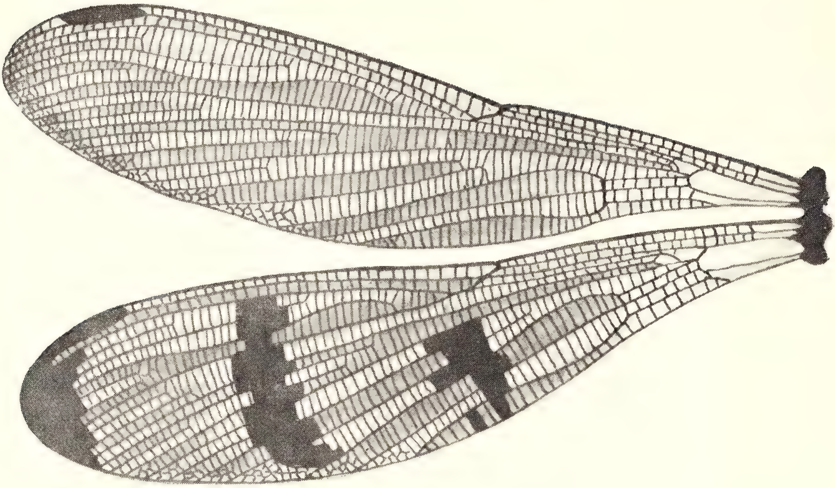
Abdomen glossy black with a small apical spot of yellow on the sides of segments 1 and 2. Anal appendages black and similar in shape to those of *cuneata*.



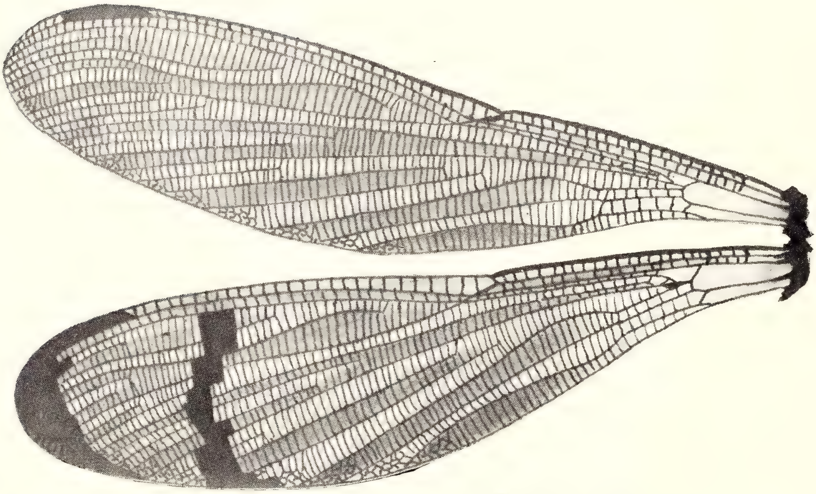
1. WINGS OF *Rhinocypha unimaculata*, SELYS., MALE.



2. WINGS OF *Rhinocypha trimaculata*, SELYS., MALE.



1. WINGS OF *Rhinocypha trifasciata*, SELYS., MALE.



2. WINGS OF *Rhinocypha bifasciata*, SELYS., MALE.

Female. Abdomen 18 mm. Hindwing 28 mm.

Head similar to the male but a medial spot on hinder border of occiput and a moderately sized, bright yellow spot on each cheek near the eyes continued up as a very narrow streak against the eyes.

Prothorax with an additional large spot just below the posterior lobe. Thorax with the mesothoracic triangle present, yellow in its upper half, this colour continued narrowly along both sides of the triangle below. The lateral markings are broader than in the male, and there are some additional markings as follows :—An upper antehumeral spot and a lower stripe, widely separated, a fine posthumeral stripe broadly interrupted above where it lives a tiny upper point, and not extending downwards as far as anterior border of thorax. There is also a fine broken line on the first lateral suture and a small spot on upper part of mesepimeron.

Wings evenly and palely enfumed throughout, with a pale greenish tint. Pterostigma black, its outer half or two-thirds yellowish. Discoidal cells with 3 to 5 traversing nervures ; 15 to 18 antenodal nervures.

Abdomen black marked with ochreous as follows :—A large lateral spot on segment 1, an apical spot and a basal stripe on segments 2 to 4, segment 5 with a small basal spot only, whilst segments 2 and 3 have a vestigial ventral stripe also.

Anal appendages and vulvar scale similar to the genus.

Distribution. Bengal—and Assam, more especially the latter. The type in the Selysian collection, in the Brussels Museum, is from Darjeeling. I have seen several specimens taken at Gopaldhara by Mr. H. Stevens during October and November.

There is no difficulty in distinguishing this beautiful species, the two opaque bands at once determine it, *hilaryæ* having the inner band much nearer the pterostigma, and the vitreous area limited to the outer apical area of wing.

The wings of this species and *trifasciata* are markedly pleated and if held in certain positions, one set of pleats glows with a satin-like violety blue sheen, whilst the other set shines emerald green. The restricted markings of the head will distinguish the female from other Indian species.

Rhinocypha trifasciata, Selys, Syn. Cal. p. 61 (1853) ; Id. Mon. Cal., p. 207, (1854) ; Walk. (*Libellago-trifasciata*) List. Neur. Ins. B. M. iv. p. 650, n. 13 (1853) ; Kirby, Cat. Odon., p. 113 (1890) ; Laid. Rec. Ind. Mus., vol. xiii, p. 34 (1917).

Male. Abdomen 24 mm. Hindwing 27 mm.

This species is very similar to the last, but is invariably larger, and the male bears an additional opaque band on the hindwings.

The head markings exactly similar to those of *bifasciata*.

Prothorox black with a middorsal longitudinal spot on the posterior lobe bluish in colour.

Thorax black marked very similarly to that of *bifasciata*, the mesothoracic triangle very large, extending from the alar sinus to the anterior border of thorax, pale blue in colour. A fine yellow line on the first lateral suture, broken above, a shorter line on the second lateral suture, incomplete below, a small spot below the root of the forewing. and the usual irregular broken stripe along the lower part of sides of thorax. This consists of a smallish spot on the metepimeron, triangular in shape, an elongate spot on the mesopimeron, with a cuneiform angulate spot at its anterior part.

Wings similarly coloured to those of *bifasciata*, the vitreous area of equal extent and bluish violaceous or emerald green according to the angle from which viewed. Three blackish brown bands traverse the hindwings from costa to posterior border. An apical band extending in to outer end of pterostigma, its inner border concave ; a medial band situate at about the junction of outer and middle thirds of wing, with serrate concave inner border, slightly sinuous convex outer, from 6 to 8 cells wide. An inner band with its inner border in line with or slightly distad of level of node, limited costalwards by *Riii*, reaching the hinder border of wing, moderately straight on its proximal border, with three outer prolongations on its distal border.

Pterostigma blackish brown, the central part, of that of hinder wings, paler ; 20 to 22 antenodal nervures ; discoidal cells traversed 6 times.

Abdomen black marked on segments 1 to 3 with a small apico-lateral spot of yellow. Anal appendages black, shaped as for genus.

Legs black, the two hinder pairs of femora and tibiæ heavily pruinosed white.

Female. Abdomen 22 mm. Hindwing 29 mm.

Very similar to that of *bifasciata* but considerably larger. The mesothoracic triangle long and broad as in the male, dark ochreous in colour. Markings of head, thorax and abdomen exactly as in *bifasciata*, with the exception of the mesothoracic triangle which is as described above.

Distribution. The type in the Selysian collection, in the Brussels Museum, is labelled ' India,' without further indication of its origin. Three males in the Indian Museum, Calcutta, are from Kailana, N. W. Provinces so that it would appear that this species has a more northerly and westerly distribution to that of *bifasciata*. The two species are undoubtedly distinct, although closely related. The opaque bands of hindwings are subject to considerable variation in shape and length. That depicted on Plate II shows an abbreviation of the stripes, whilst the description given above is from a specimen in my own collection.

Rhinocypha bifenestrata, Fras. Mem. Dept, Agric. Ind. Ent. Series, vol. vii, No. 7, p. 63 (1922).

Male. Abdomen 25 mm. Hindwing 27 mm.

Head black, labium and labrum unmarked. A small oval yellow spot on the outer side of each hinder ocellus, and a smaller rounded spot on each side of occiput.

Prothorax black, unmarked.

Thorax black marked with yellow as follows :—A vestigial broken posthumeral line, incomplete below, a narrow stripe bordering along the front of second lateral suture and a small spot below the hindwing. Mesothoracic triangle extending from the alar sinus to the anterior border of thorax, pale lilaceous in colour.

Legs black, the two hinder pairs of tibiæ only pruinosed white.

Wings largely opaque by fusion of three broad bands which enclose two large vitreous spots. Base of wings as far as outer end of discoidal cell hyaline, rather brightly saffronated. The opaque area in the forewings variable, usually broadly serrated and limited posteriorly by *IRiii*, but sometimes more closely serrated and extending as far back as *MA* at the base and *IRiv* nearer the apex of wing. The hyaline area posterior to the opaque area vitreous and a beautiful violet by reflected light, extending basad at one point to proximad of the outer end of discoidal cell. In the hindwings the opaque area extends proximad as far as 3 or 4 cells proximad of the node near costal margin of wing, and from thence runs obliquely out to posterior border of wing, with a very irregular border. By a confluence of the three bands, two large vitreous spots, violaceous in colour, are enclosed, varying much in size and shape in individual specimens. In the type the outer two bands are not much wider than in *trifasciata*, being narrowly connected along the costal and hinder borders of wing, but in some specimens, the apical opaque band extends as far in as slightly proximad of inner end of pterostigma. The inner spot is usually partially bisected by a prolongation of the inner band, one cell wide, running posterior to *Riii*, and in some specimens, this prolongation actually fuses with the middle band, thus completely bisecting the inner vitreous spot. In the type, the middle and inner bands are only very narrowly confluent along both costal and hinder margins of wing, so that the inner spot is of large dimensions. Pterostigma black, its outer three-fourths white, but clouded with light brown in forewings ; antenodal nervures 19 to 20 ; discoidal cells traversed 6 times.

Abdomen black, quite unmarked. Anal appendages black, shaped as for genus.

Female. Abdomen 21 mm. Hindwing 31 mm.

Head ; labium and labrum black ; rest of head velvety black marked with bright ochreous as follows :—A large spot at base of mandibles, a narrow streak against the eyes expanding on to the cheeks, a narrow longitudinal streak on lower part of epistome, a tiny point just in front and to the outer side of middle ocellus, and two linear spots on frons in front of latter, a large rounded spot on outer side of each outer ocellus and a similar postocular spot behind it, lastly a large triangular spot at the middle of hinder border or occiput. These markings liable to some variation thus the spots on the frons may be very large and triangular, or they may be entirely absent, the occipital spot may be small and linear or large and crown-shaped.

Prothorax black marked with bright ochreous :—A middorsal longitudinal streak running from posterior lobe on to middle lobe, a small spot on lower part of posterior lobe and a spot on each side of middle lobe which may be large and triangular or reduced to a mere point.

Thorax black marked with bright ochre as follows:—The mesothoracic triangle except for its lower part, the intersecting suture of the alar sinus, a very fine antehumeral stripe, often broken into a chain of tiny points and best defined in its lower part, a posthumeral stripe incomplete below, broadly broken in its upper part, a linear spot on upper part of mesopimeron and a fine incomplete line bordering the first lateral suture; finally a broad irregular broken stripe on lower part of sides of thorax and two small rounded spots beneath.

Legs black, tibiæ not pruinosed.

Wings uniformly enfumed brown; pterostigma black, slightly clouded in its outer part with yellow; discoidal cells traversed 4-5 times; petiolation short, from near the first antenodal nervure or between the first and second; 20-21 antenodal nervures, 32-34 postnodals.

Anal appendages and vulvar scale as for genus.

Abdomen black marked with bright ochre as follows:—A small cuneiform spot on each side of segment 1, a small apico-lateral spot followed by a short streak, and a ventral stripe on sides of segments 2 to 4, segments 5 and 6 similar but the upper streak obsolete and the apical spot much reduced.

Distribution. Moungpoo, British Sikhim, 8,600 ft. from May and June, and again in August to September. Mr. Inglis has also taken it in April but it is rare during that month. Mr. Inglis, Mr. Shaw and myself took upwards of forty specimens at the end of May along the beds of streams, usually settled on rocks, and never engaging in sustained flight like *besignata*. This species is, I think, more nearly related to *cuneata* than to *bifasciata*, but appears to link up groups *cuneata* and *bifasciata*, and may have originated by a fusion of the opaque bands of *trifasciata*. Type in the British Museum.

Rhinocypha immaculata Selys. Bull. Acad. Belg. (2) xlvii, p. 385 (1853); Kirby, Cat. Odon. p. 113 (misprinted as *unimaculata*), 1890; Laid. Rec. Ind. Mus., vol. xiii, pp. 34, 35 (1917).

Male. Abdomen 22 to 25 mm. Hindwing 27 to 28 mm.

Head black marked with blue and ochreous spots as follows:—The bases of mandibles, the cheeks, and a stripe bordering the eyes, a reniform spot on each side of the frons, and a smaller rounded spot just behind these pale blue. An oval spot on the outer side of each posterior ocellus and a round postocular spot on each side of the occiput ochreous. Labium and labrum unmarked.

Prothorax black marked with a middorsal longitudinal blue line beginning on the posterior lobe, and a large spot on each side.

Thorax black marked with bright yellow as follows:—A fine lower antehumeral stripe, a fine upper humeral incomplete below, a small upper spot near the first suture, a thick irregular broken stripe on lower part of sides consisting of a triangular spot on the metepimeron and an irregular longitudinal stripe on the mesepimeron. Four to six yellow spots on underside of thorax. The mesothoracic triangle very large, extending from anterior border of thorax to the alar sinus, pale blue in colour.

Legs black, the hinder pairs of femora yellow on flexor surface, the tibiæ of the same legs pruinosed white.

Abdomen black marked with yellow as follows:—A small spot on each side of segment 1, a lateral stripe and an apical spot in line with former on segments 2 to 5, finally a ventro-lateral stripe on segments 3 to 6, not extending as far as apex of segment.

Anal appendages black, shaped as for genus.

Wings entirely hyaline, the only species of the genus in which they are so. Shaped as for *trifasciata*, 15 to 16 antenodal nervures, discoidal cells with 5 to 6 traversing nervures; pterostigma blackish brown, the outer and costal part much paler or yellowish.

Female. Abdomen 22 mm. Hindwing 28 to 30 mm.

Very similar to the male. The markings of the head better defined, and all bright yellow in colour.

Thorax with a large mesothoracic triangle, outlined in yellow, black at its centre, other markings rather broader.

Legs black, not pruinosed.

Wings hyaline, occasionally enfumed in old adults; pterostigma black, whitish in its outer part; antenodal nervures 16 in number.

Abdomen black marked as for the male described above. In very adult males, the lateral stripes on 3 to 6 are lost, the apical spot alone remaining, or even lost on segments 4 to 6.

Anal appendages and vulvar scale as for genus.

Distribution. Known only from Cherrapunji, Khasia Hills, Assam. On the wing during September and October. This interesting species is easily distinguished from all others by the total absence of markings on the wings or even vitreous iridescense. Cherrapunji being about the wettest spot on earth, approaches the primitive conditions in which the ancestral dragonflies first evolved and so might be expected to preserve those forms lacking in heliochromatic markings. *Immaculata* undoubtedly stands somewhere near the base of genus *Rhinocypha*.

Rhinocypha hilaryæ, Fras. Rec. Ind. Mus., *M.S.*

Male. Abdomen 21-22 mm. Hindwing 27 mm.

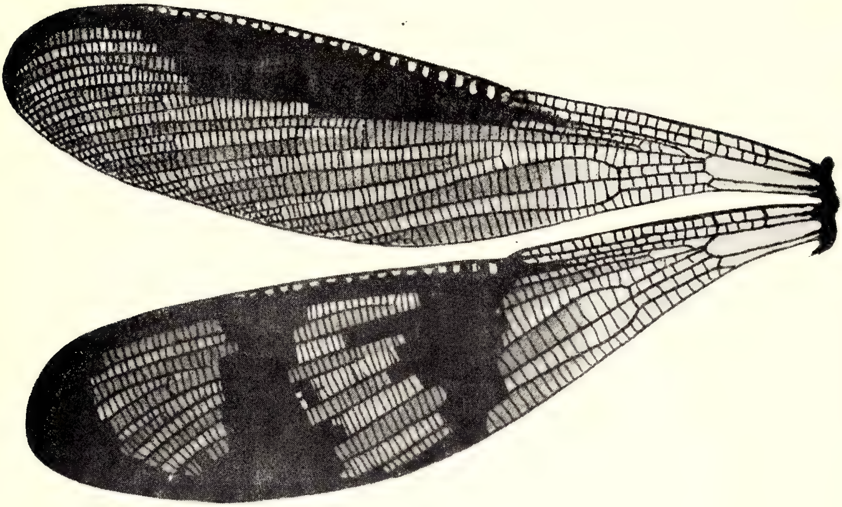
Head: labium black, the lateral lobes creamy white; labrum azure blue, its anterior border and base narrowly black, the basal black with a median point; epistome glossy black in front, velvety black above, with a small triangular spot of blue on each side; frons with a large quadrangular blue spot on each side with its outer angle pointed and prolonged outward, the two spots very narrowly separated, and confluent with two large subrotundate spots of the same colour on the vertex, which lie in close apposition to the median ocellus. Laterally the bases of mandibles, the penultimate segment of antennæ, and a narrow irregular stripe bordering the eyes bluish. Lastly a tiny point on the outer side of each lateral ocellus, another on each side of occiput and a small linear spot at its middle. (In dried specimens, these markings are yellow or greenish blue, but in life, the adult markings are always blue.)

Prothorax black marked with blue, bluish green or yellow according to the age of specimen:—A narrow median linear stripe which begins on the posterior lobe and tapers to infinity anteriorly, a small triangular spot on each side of posterior lobe and a short oval spot on each side middle lobe.

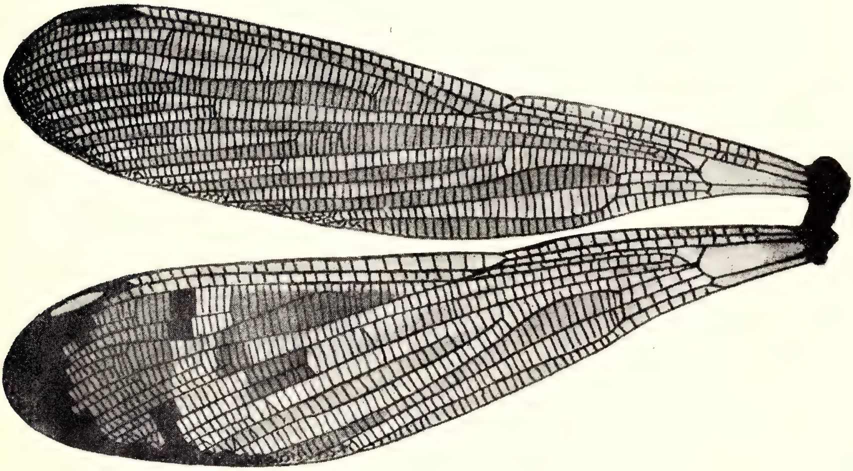
Thorax black marked with blue and yellow as follows:—The mesothoracic triangle pale turquoise blue, elongate, extending as far up as alar sinus, a fine humeral stripe azure blue, laterally an irregular thick interrupted stripe extending the whole length of thorax, rather zig-zagged anteriorly and broadened into an elongate triangular spot on the metepimeron.

Legs black, the two hinder pairs of tibiæ and distal parts of the same femora pruinosed white on the flexor surfaces.

Wings hyaline, palely enfumed with greenish yellow, marked with opaque black and vitreous violet areas as follows:—Forewing with only the extreme apex bordered or clouded with opaque black; pterostigma black; hindwing with apex broadly opaque black, the inner border of the opaque area serrated, running almost straight back from middle of pterostigma to hinder border of wing, and finally continued as a narrow border along the hinder edge of wing for about its apical fourth. At a short distance from the proximal end of pterostigma is seen a narrow opaque black fascia nearly always broadly broken at its middle into a small quadrate or angulate spot lying between *Rii* and *IRii*, and a markedly irregular spot confluent with the narrow black bordering of wing. Rarely the two spots are united by a narrow isthmus, but in no two specimens are they ever exactly alike. The vitreous violet areas comprise the whole of the area included between the apical black bordering and the irregular fascia, as well as three linear spots situate between the level of node and narrow black fascia, nearer the latter than former. Of these, the anterior stripe is the longest, about 20-25 cells long, and situated between *Rii* and *Riii*, the median stripe, lying between IRiii and *Riv* + *v*, is half the length of the former, its outer end in line with the outer end of same; finally the third or hinder spot, lying between *MA* and *Cuii*, is very narrow and continues outward along posterior border of wing to become confluent with the narrow opaque black border; pterostigma black with a large oval pale blue spot in its outer two-thirds; discoidal cell traversed 4 to 5 times; petiolation variable, begins opposite the 2nd or 3rd antenodal, but is usually opposite the 2nd; 17-19 antenodal nervures, 28-38 postnodal nervures (very variable).



1. WINGS OF *Rhinocypha bifenestrata*, FRAS., MALE



2. WINGS OF *Rhinocypha hilaryæ*, FRAS., MALE

Abdomen black marked with bluish green or yellow as follows :—Segment 1 with a large lateral triangular spot on each side, segment 2 with a similar spot situate at the apex, as well as a ventral stripe nearer the apex than base of segment ; segment 3 similar, but the apical spot smaller and the ventral stripe longer, extending for nearly the whole length of segment, segments 4 and 5 similar to 3, but the markings becoming obsolete, 6 and 7 with vestigial ventral stripes only.

Anal appendages similar to genus.

Female. Abdomen 21–22 mm. Hindwing 30–32 mm.

Head. Markings similar to those of male but bright yellow instead of blue. The lateral spot on epistome larger, and in addition, a lateral stripe on either side of its front.

Prothorax similar to male.

Thorax black marked with bright yellow as follows :—The mesothoracic triangle outlined in yellow, the two lateral lines converging and fusing above and then continued as a median line bisecting the antealar sinus. A fine complete antehumeral stripe curving slightly out above, and in below ; a fine humeral stripe incomplete below ; a strongly curved stripe on upper part of mesopimeron, and lastly the same broad irregular stripe traversing the whole length of lower part of thorax, as seen in the male.

Wings hyaline, palely enfumed throughout, tinted slightly with yellow, especially at the base ; pterostigma black, its outer part bearing a broad oval yellowish spot ; 15–19 antenodal nervures, 26–31 postnodals ; discoidal cell traversed 2-4 times ; petiolation begins between the 1st and 2nd antenodals.

Abdomen black, similar to the male but markings yellow : segments 2 and 3 have also a lateral stripe lying above and parallel to the ventral stripe, in line with but not confluent with the apical spot, whilst the ventral stripe is obsolete after segment 3 and all markings after segment 6.

Anal appendages and vulvar scale as for genus.

Distribution. Maymyo, Upper Burma. Quite a number of both sexes were taken by Col. F. Wall, I.M.S., during the months of June, July and August. The insect appears to be remarkably local which may account for so striking and beautiful insect not having been discovered before. The shape of the mesothoracic triangle and the wings show it to belong to group *bifasciata*. It can only be confounded with *bifasciata*, in which however the proximal fascia is complete and situated much nearer the node, the vitreous area also covering nearly the entire wings.

(*To be continued*)

BIRD NOTES
FROM THE MOUNT EVEREST EXPEDITION OF 1924

BY

MAJOR R. W. G. HINGSTON, I.M.S.

(*With a plate.*)

The following notes are necessarily scrappy. Owing to the religious scruples of the people all shooting was prohibited in Tibet. We took no collecting-guns into the country. My notes are thus confined to field observations, and to those species which could be definitely identified. A collection of skins from the same area had previously been made by Mr. Wollaston during the first Mount Everest Expedition. A report on these was prepared by Mr. N. B. Kinnear and published in the Ibis for July 1922. This report has been of the greatest help in the identification of many species. Mr. Kinnear also supplied special notes to the expedition, and gave me much assistance after its return. I also had the advantage of Colonel Norton's help and his detailed knowledge of Tibetan birds. When at Darjeeling, Mr. C. M. Inglis showed me his collection of skins which included almost all those likely to be met with on the plateau. The birds of Tibet are unusually distinctive, and by making use of the above sources of information it was possible in almost all cases to identify the species in the field.

Corvus corax tibetanus. The Himalayan Raven.

A common bird of the Tibetan plateau. One of the chief scavengers of villages. Haunts forts. Comes to camps. Takes the place of vultures in devouring carcasses. Seen at the base-camp, 16,500 feet; at the summit of the Pang La, 17,200 feet; at Camp 3 on Mount Everest, 21,000 feet.

Corvus coronoides intermedius. The Himalayan Jungle Crow.

Common all through the Chumbi and Rongshar valleys. Seeks the vicinity of villages and cultivation. Associates with choughs above the level of the trees. Nests at Gautsa, 11,500 feet. Also met with on the plateau, though partially replaced there by the raven. Followed us up to Camp 3 at 21,000 feet

Pica pica bottanensis. The Black-rumped Magpie.

A village bird of the Tibetan Plateau, 13,500 to 15,000 feet. Frequents buildings, cliffs and cultivated fields. In the few places where there is a clump of trees magpies are certain to be found. Nests seen at Khampa Dzong, 14,000 feet, on a solitary village tree: at Kyishong, 14,000 feet on the top of a low bush only six feet above the ground: at Shekar, 14,000 feet, similarly situated in a thorn bush. These nests are immense and very conspicuous. They appear to be permanent habitations which serve in winter as a shelter for the birds. The distribution of the species must be chiefly limited by the few places available for the building of nests.

Nucifraga caryocatactes hemispila. The Himalayan Nutcracker.

Seen frequently during June in the Rongshar valley that leads from Tibet into Nepal on the west side of Mount Everest. Altitude 9,000 to 10,000 feet. In 1922 Colonel Norton observed it in the Karma valley during June at 13,000 feet.

Pyrrhocorax pyrrhocorax. The Common Chough.

Noisy flocks common in the Chumbi valley up to the summit of the Jelap La, 10,000 to 14,000 feet. Haunt the high cliffs and caves in the rocks. Abundant around the forts of Tinki and Shekar where numbers of them nest in holes. Flocks feed in the cultivated fields of the plateau, where, though joining in a gregarious company, they yet scatter about in individual pairs. Also met with in the Rongshar valley at 11,000 feet. Nests taken (1) on 10th July at Kyishong, 14,500 feet; situated in hole on earth cliff; contained young; (2) on April 17th in Chumbi valley at 10,000 feet; situated in recess under eaves of house; composed of sticks thickly lined with moss and wool; contained three eggs newly laid. This chough was not seen above 15,000 feet.

Choughs in Everest Base Camp.

Blue Hill-Pigeons in Everest Base Camp.

Brown Accentor in Everest Base Camp.

Adams's Mountain-Finch in Everest Base Camp.

Pyrrhocorax graculus. The Aipine Chough.

A bird of higher altitudes than the previous species. A permanent resident of our base-camp at 16,500 feet. In camp it was extremely tame, as impudent and daring as the housecrow, living on the scraps thrown out of the cooking-place, and spending the day amongst our tents. On the cliffs it used to associate with herds of Burhel, picking insects out of their hair. It came regularly to Camp 1 at 18,000 feet, and to Camp 3 at 21,000 feet. Somervell saw flocks around the summit of Kharta Phu at 23,640 feet. These birds followed the climbers to all the high camps, reaching even Camp 6 at 27,000 feet. This is the greatest height at which living things have yet been seen.

Podoces humilis. Hume's Ground-Chough.

A common bird of the Tibetan plateau up to 15,000 feet. Also seen within Indian limits, at Tangu in Northern Sikhim, near the Tibetan border, altitude 14,300 feet. An active little bird with feeble powers of flight. Assumes a peculiarly erect attitude, moves over the ground in long hops, bowing its head and flirting its tail. Frequents stone walls, the roofs of buildings, enters villages freely, sometimes found in the most barren tracts. Harmonizes well with its plateau haunts. Bores into the soil in search of food. Frequently investigates animal droppings, breaking them and turning them with its strong beak. Remains of ground-beetles found in its stomach. Nest found at Tingri on July 4th ; altitude 15,000 feet. Situated far down in deserted pika burrow. I followed down the burrow for four feet, but was still far from reaching the nest. The parent birds came round with morsels in their beaks showing that the nest contained young.

Parus monticola. The Green-backed Tit.

A common bird of the Chumbi valley where it joins with warblers in an insectivorous flock.

Lophophanes rufonuchalis beavani. The Sikkim Black Titmouse.

A flock of tits, probably this species seen in the silver fir trees below the Jelap La at 11,000 feet.

Trochalopterum affine affine. The Black-faced Laughing Thrush.

A common bird of the Chumbi valley. Often seen skulking in bushes near the torrent, but not noticed above the trees. A small flock was seen amongst the conifers at 13,000 feet.

Myiophoneus temminckii. The Himalayan Whistling Thrush.

Common in all the high Himalayan gorges. Seen in the streams of the Chumbi valley up to 12,000 feet. Also up to the same altitude in the Rongshar gorge.

Tichodroma muraria. The Wall Creeper.

Seen first in the Chumbi valley clinging to boulders in the valley bed. Occasionally met with on the Tibetan plateau, on the slatey rocks at Shekar, 14,000 feet ; on the high cliffs of the Dzakar Chu at 15,000 feet ; on the cliffs above our base camp in the Rongbuk valley at 18,000 feet. It finds spiders in the crevices of these high rocks, and its body harmonizes well with the background as it climbs from place to place.

Lanius schach tephronotus. The Grey-backed Shrike.

Numbers seen in the Chumbi valley at 10,000 feet. Birds arrive in the middle of April. Also seen in the Rongshar valley between 11,000 and 12,000 feet. Some birds pass over on to the Tibetan plateau. We saw one in thorny scrub near Kyishong at 15,000 feet. In 1922 Norton and Longstaff observed it along the Dzakar Chu, 14,000 feet, and the lower Phung Chu, 13,500 feet.

Oenanthe deserti oreophila. The Desert Chat.

Frequently met with on the plateau between 14,000 and 15,000 feet, and on the passes up to 17,000 feet. Particularly likes stony places where the boulders give it points of vantage. Also likes to settle on tufts of grass or clumps of thorny scrub. Seen in the valley of the Phung Chu where the ground was white with a saline efflorescence. Nest taken at Tingri on July 4, altitude

15,000 feet. Situated in tunnel on earth cliff, one foot in depth ; composed of dry grass and fine sticks thickly lined with animal hair ; contents, four eggs hard set.

Microcichla scouleri scouleri. The Little Forktail.

Not seen on the plateau, but at 9,500 feet in the deep Rongshar gorge that leads from Tibet into Nepal.

Chaimarrornis leucocephalus. The White-headed Redstart.

Common in the high Himalayan streams. Not seen on the open plateau. Met with at Gautsa, 12,000 feet, near the furthest limit of the trees. Very common throughout the Rongshar gorge up to 13,000 feet.

Phœnicurus frontalis. The Blue-fronted Redstart.

Extremely abundant through the Chumbi valley, 10,000 to 11,000 feet. Only a few had arrived by the beginning of April, though numbers were present later in the year, seen on the Jelap La at 13,000 feet, but does not seem to cross over on to the plateau.

Phœnicurus hodgsoni. Hodgson's Redstart.

A bird, which I take to be this species, was twice seen on the plateau ; in the ploughed fields near Tashidzom at 14,500 feet ; and at the fort of Shekar, 14,000 feet. There is no mention of this species in Mr. Kinnear's list of the birds of the first Expedition.

Phœnicurus ochrurus rufiventris. The Indian Redstart.

Frequently met with on the Tibetan plateau between 13,000 and 16,000 feet. Frequents stony wastes, rocky hillsides. Comes around villages, and especially likes the grassy patches where it captures insects in a few quick hops. It occasionally came to the Everest base camp at 16,500 feet. We met it at a similar altitude on the Pang La, though not at anything approaching Wollaston's record of 20,000 feet.

Phœnicurus erythrogaster grandis. Guldenstadt's Afghan Redstart.

Met with occasionally at high altitudes : on the summit of the Kongra La, 16,000 feet ; in the Rongbuk valley, 16,000 feet ; on both sides of the Phusi La, 16,500 feet. It ascends to the junction of the torrents with the glaciers. Seen on Mount Everest up to 18,000 feet where it visited both our base camp and Camp 1. Its habits are like those of the white-capped species which it replaces at greater heights. It takes insects amongst the boulders along the torrent, and alights as readily on pinnacles of ice as it does on rocks and stones. A pair had a nest near the base camp at 16,000 feet.

Rhyacornis fuliginosa. The Plumbeous Redstart.

Very common in the streams of the Chumbi valley up to 12,000 feet. Also through the Rongshar gorge up to about the same altitude. Apparently does not pass on to the Tibetan plateau.

Ianthia rufilata. The Red-flanked Bush-Robin.

Common in the Chumbi valley up to 11,500 feet. Apparently does not cross over on to the plateau.

Planesticus merula. The Himalayan Blackbird.

Seen only on one occasion : in thorny gorse near Kyishong at 15,000 feet.

Planesticus albicinctus. The White-collared Ouzel.

Seen at Yatung in the Chumbi valley, 10,000 feet. A pair had established themselves in the scrub around the rest-house.

Merula ruficollis. The Red-throated Ouzel.

Seen in the Chumbi valley amongst scrub at the edge of the torrent, altitude 10,000 feet.

Monticola solitaria pandoo. The Indian Blue Rock Thrush.

Seen in July by Norton in the Rongshar valley at 16,000 feet. Not met with on the Tibetan plateau.

Cinclus cinclus kashmiriensis. The Kashmir Dipper.

An inhabitant of the deep gorges. Nowhere seen in the more peaceful streams of the plateau. Met with in the Chumbi valley at 10,000 feet, above Gautsa at 14,000 feet, in the Rongshar torrent at 10,000 feet.

Lioscopus collaris nepalensis. The Eastern Alpine Accentor.

Not seen on the open plateau. Met with below the Jelap La at 13,000 feet; also near the head of the Rongshar valley at 15,000 feet. Wollaston saw this bird at the great height of 21,000 feet.

Prunella rubeculoides. The Robin Accentor.

Widespread on the Tibetan plateau, 14,000 to 16,500 feet. Seen at almost every village. Also at Gautsa in the Chumbi valley, 13,000 feet. It haunts the boundary walls between the cultivated fields and the rocks near Tibetan forts. May be seen skulking in nullahs and water-channels and under moraine boulders. Its village habits are like those of the brown accentor. It feeds mainly near the village walls where it picks seeds out of animal dung. Numbers were seen at the village of Kyishong in company with the brown accentor. It was met with on the moraines at Kyetrak, 16,000 feet; also as a visitor to the Everest base camp at 16,500 feet.

Prunella fulvescens fulvescens. The Brown Accentor.

A common bird of the plateau. Frequents villages, stone bridges, chortens, mani-walls, which places supply nooks where it can skulk and hide. Finds food amongst village refuse in the streets and in the manure-heaps on the roofs of houses. Seen on the Pang La at 17,000 feet. Also came to boulders near our base camp at 16,500 feet. Numbers were seen in the willows at Kyishong. But, since trees in Tibet are so very scarce, the accentors, like the magpies and the tree-sparrows, have become almost altogether village birds. They were as common as sparrows in the little village of Kyishong. Longstaff records a pair nesting in May at the Everest base camp. Nest composed of a cup of fine grass lined with bits of wool and hair placed on a platform of sticks in a deep gap between expedition ration boxes.

Prunella strophiatus strophiatus. The Rufous-breasted Accentor.

Seen only in the Chumbi valley. Small flocks were common on stone walls and in low scrub, altitude 10,000 feet.

Pyrrhula erythrocephala. The Red-headed Bullfinch.

A few pairs seen in the Chumbi valley, 11,000 to 12,000 feet. Also in the deep Rongshar gorge at 12,000 feet.

Pyrrhospiza punicea punicea. The Red-breasted Rose-Finch.

A bird of the Tibetan plateau. Seen at Kyishong and Tashidzom, altitude 14,000 feet. Also on the Phusi La at 16,500 feet. Occupies willow plantations. Haunts villages and frequents cultivated fields. In a flock the females are far more numerous than the males.

Propasser pulcherrimus. Subsp. ? The Beautiful Rose-finch.

Seen in the Chumbi valley. A pair in rhododendron scrub on the Jelap La at 13,000 feet. Also in the snow at Chumbitung, 12,500 feet. These birds shelter from the snow under ledges of rock, or, like sparrows, beneath the eaves of rest-houses.

Carpodacus rubecilloides. Przewalski's Rose-Finch.

A bird of the plateau. Seen at Khampa Dzong, Lingka, Tinki Dzong, altitude 14,500 feet. Comes about villages. Feeds in cultivated fields. Longstaff in 1922 noted it at Tinki Dzong.

Acanthis flavirostris rufotriata. Walton's Twite.

Frequently met with on the plateau in July. Not seen in April. Haunts grassy tracts and cultivated land. Altitude, 13,500 to 14,500 feet.

Passer montanus. Subsp. ?. The Tree Sparrow.

Common around all human habitations. Almost exclusively a village bird. Congregates in flocks. Strikingly tame. Likes the vicinity of vegetation. Feeds in the streets and at village walls. Replaces the domestic sparrow around human habitations, yet likes trees when they are available, though such are rare in Tibet.

Montifringilla blanfordi. Blanford's Mountain-Finch.

Fairly common on the plateau at 14,000 to 15,000 feet. Seen around villages and in cultivated fields. Associates with Pikas in grassy places. Feeds with sparrows near the walls of houses, sometimes in considerable flocks. Nest at Shekar on July 7, altitude 15,000 feet: situated at bottom of a deep pika burrow; nest in process of being built, and parent birds busy bringing feathers and hair. Longstaff in 1922 met with a nest at Trangso Chumbab on June 11, altitude 14,000 feet. Female was netted at nesting hole and identified. Both parents were feeding young more than four feet down mouse-hare hole. He imprisoned male in the hole beneath a foot of sand through which it burrowed during the night. Longstaff states that both birds burrow very quickly, using the bill only, with a quick rotary movement sending the sand flying centrifugally. Norton records the Pika burrows at Tatzang covered with these finches on July 17; and observed them feeding well grown young near Phari, 14,000 feet, on July 20.

Montifringilla ruficollis. The Red-necked Mountain-Finch.

A delightful little bird living in the company of mouse-hares and feeding around the mouths of their burrows. Common on the grassy plains of the plateau and wherever there are pika colonies. Altitude 14,000 to 15,000 feet. Norton notes it at Gnatong April 1, at Yatung April 4, at Phari April 7.

Montifringilla mandelli. Mandelli's Mountain-Finch.

A bird of local distribution. Seen on the Phari plain, the Tingri plain, and the large plain on the further side of the Donka La, but not at intervening places. Lives in the company of pikas. Seen entering pika burrows where it undoubtedly breeds.

Montifringilla nivalis adamsi. Adams's Mountain-Finch.

Seen occasionally on the plateau. At Gyankar Nangpa, 14,000 feet: at Chiblung, 14,500 feet; at Shekar, 15,000 feet. An occasional visitor to the Everest base camp at 16,500 feet. Nested close to the base camp in June. Feathers were being carried into a tunnel in the moraine, but the nest could not be reached as it was more than an arm's length down the hole. In 1922 Norton met with it constantly from Phari to Everest, except in the Karma and Kharta valleys, but not below 13,500 feet.

Fringillauda nemoricola nemoricola. Hodgson's Mountain-Finch.

A common bird of the plateau, from 14,000 to 17,000 feet. Remarkably tame. Comes about villages. Frequents grassy patches and cultivated fields. Picks in the dung with tree-sparrows around the houses. Also found in barren stony wastes. A common resident of our Everest base camp. Apparently likes to haunt the passes. Seen on ascent and descent of Phusi La, 16,000 to 17,000 feet; and near the summit of the Lamna La at 17,000 feet. In 1922 Longstaff notes that a pair frequented the Everest base camp during May and that small flocks were met with on the slopes leading up to the Sepo La at 17,000 feet. Norton notes it as common everywhere high up, but not seen in Karma or Kharta valleys or lower Phung Chu. He met a pair at Camp 1 on Mount Everest, altitude 18,000 feet.

Cotile riparia. The Sand Martin.

Sand Martins were fairly common on the plateau up to 14,500 feet. Seen busily circling over the streams and lakes at Tinki, Tingri and Shekar. Norton during the second expedition, on April 18, observed numbers around Tinki lake, apparently having just arrived, as none had been there on the previous day.

Ptyonoprogne rupestris. The Rock Martin.

Haunts places on the plateau where there are crags and cliffs. Seen in the gorge near Shillong, 14,000 feet; around the cliffs above Kyishong; and in the gorge at Khampa Dzong, 14,500 feet.

Motacilla alboides. Hodgson's Pied Wagtail.

Frequently seen along mountain torrents; in the Chumbi valley at 10,000 feet: above Gautsa at 13,500 feet. Also along the plateau streams at about 14,000 feet: and throughout the Rongshar gorge between 9,000 and 11,000 feet.

Motacilla citreola calcaratus. Hodgson's Yellow Wagtail.

Met with on the plateau in marshy places and at the edges of lakes. Altitude 13,500 to 15,000 feet. In 1922 Norton and Longstaff noted it at Gyanka Nampa and along the Chiblung Chu.

Anthus roseatus. Hodgson's Pipit.

Numbers during April in the Chumbi valley, probably migrating to higher altitudes. Also seen in July in the Rongshar valley at 15,000 feet. Not noticed on the Tibetan plateau. In 1922 Norton observed it below the Chog La at 15,000 feet, probably nesting.

Otocoris alpestris elwesi. Elwes's Shore-Lark.

Abundant and widespread on the plateau. A common bird of every village. It is usual to see hill-pigeons, tree-sparrows, accentors, horned larks and others feeding near the village wall. It also frequents cultivated fields. Enters into association with the Pikas that tunnel everywhere into the plateau soil. Feeds at refuse heaps and in patches of grass. Seems to find food in the barest place. The stomachs of a few examined contained small seeds and fine grit. Very common on the large plains, such as those near Phari, Tingri and Tuna. Apparently likes to haunt the passes. Seen on the ascent to the Lamna La at 16,000 feet, to the Phusi La at 16,500 feet, to the Pang La at 17,000 feet. Also on the moraine of the Rongbuk glacier at 18,000 feet. Used frequently to visit our Everest base camp where it found scraps amongst the tents. Nests taken,—(1) At Tingri, July 4, 15,000 feet; in cavity on earth bank; composed of grass lined with vegetable down; contained three eggs newly laid. (2) At Kyishong, July 10, 14,500 feet; in depression on ground behind ridge of earth; composed of grass lined with hair; contained two eggs hard set.

Melanocorypha maxima. The Long-billed Calandra Lark.

A conspicuous bird of the plateau. Frequents grassy and marshy places up to 15,000 feet. Utters a loud call note when in flight. Nest containing three young nearly fully fledged taken at Tingri on July 4, altitude 14,500 feet. A second nest with three young half fledged taken at Tingri on July 6, altitude 15,000 feet. Both nests composed exclusively of dried grass, and situated on an elevation in swampy ground sheltered by a stiff tuft of grass.

Alauda inopinata. The Tibetan Skylark.

Found in pasture areas and cultivated fields of the plateau. They follow the plough in search of food. Seen up to 15,000 feet. Numbers in July over the cultivated tracts near Tingri were singing and soaring like the English skylark.

Calandrella acutirostris tibetana. The Tibetan Short-toed Lark.

The most common bird of the plateau: altitude 13,000 to 15,000 feet Abundant everywhere: around villages, in cultivated fields, in marshy places on the salt-covered plains, at the edges of streams and pools. Have seen a flock of them busy on a frozen lake where they seemed to pick up something from the surface of the ice. They particularly frequent fields freshly turned over by the plough. Nests taken.—(1) At Shekar on July 7; altitude 15,000 feet; composed of grass lined with hair; situated in depression on ground under lee of tuft of vetch; contained three eggs hard set. (2) At Shekar on July 7; altitude 15,000 feet: composed exclusively of dry grass: situated in depression on sandy soil under shelter of an iris plant: contained two eggs hard set. (3) At Kyishong on July 11, altitude 14,500 feet: situated in depression on ground under shelter of vetch: composed of dried grass with the interior intermingled with a little hair; contained three eggs. (4) At Chiblung on

July 13, altitude 14,500 feet: situated in hollow on ground under shelter of vetch: composed of dried grass: contained three eggs. This last nest was of particular interest. On its exposed side was a barrier of pebbles, from ½ to 1 inch in width. This had probably been erected by the bird as a protective shelter from the wind. Buxton describes similar examples from deserts. How animals adapt themselves to wind, cold, scarcity of food and other conditions of high altitudes has been discussed in a paper 'Animal Life at High Altitudes' published in *The Geographical Journal*, vol. lxv, No. 3, March 1925.

Upupa epops orientalis. The Hoopœ.

Common everywhere on the plateau where it seems out of place in these desolate heights. Not seen above 15,000 feet, though Wollaston observed it at 21,000 feet. In the main a village bird; also likes to feed on grassy patches where the ground is wet and soft. Sometimes seen far out on the stony plains, even in the most barren spots. Haunts forts and ruined walls. In July many were nesting in holes on earth cliffs. In 1922 Longstaff records a nest with six fresh eggs in clean hole in mud wall on June 7, at Nyomda, 14,000 feet. Norton found a nest with young on July 1, in a loose stone wall near Teng.

Athene noctua bactriana. Hutton's Owlet.

A single bird flushed from heavy grass on the Lingka plain, altitude 14,500 feet.

Gyps himalayensis. The Himalayan Griffon.

Commonly seen in the mountainous valleys that lead from the plateau into the main range. Noticed only occasionally on the open plateau where its place is taken by the Lammergeyer. Seems to like circling over high passes. Some were feeding at carrion on the summit of the Pang La, 17,200 ft.

Gypaëtus barbatus grandis. The Eastern Bearded Vulture.

Numerous on the Tibetan plateau. A scavenger around the village wall where it finds carcasses and bones. Likes to circle over high passes and around the rocky Tibetan forts. In its flight it is sometimes molested by choughs. Ascends to considerable altitudes. A constant visitor to our base camp; also to camps 1, 2 and 3, up to 21,000 feet. Sometimes, when flying over snow, its under parts look completely white.

Cuncuma leucoryphus. Pallas's Fishing-Eagle.

Seen occasionally near the rivers and marshes of the plateau; 14,000 to 15,000 feet.

Milvus migrans lineatus. The Black-eared Kite.

Common on the plateau. An occasional visitor to our base camp. Kites and ravens are the two scavengers that fight over the village scraps. In 1922 Norton observed it in June and July nesting and feeding young at two or three places in the Dzakar Chu.

Falco tinnunculus. The Kestrel.

Seen frequently on the plateau up to 15,000 feet. Likes to investigate marshy places and the grassy areas inhabited by mouse-hares. Has few points of vantage from which to search for prey, and must do most of its scrutiny by poising in the air. The Kestrel and the Tibetan Tern are the two birds of these high altitudes which by hovering can hold themselves at a fixed point. Of all ærial evolutions this capacity to poise stationary in the air requires the greatest amount of muscular effort, yet these two birds can poise stationary at 15,000 feet, where the supporting power of the atmosphere is only half that at sea level, with the same skill and apparently the same facility as do kestrels and terns at ordinary altitudes.

Columba rupestris. The Indian Blue Hill-Pigeon.

A bird of the plateau. Commonly seen in flocks. Abundant everywhere, around resthouses, villages and forts. Harmonizes fairly well with the plateau soil. Unlike *C. leuconota* it haunts the round hills and open valleys as well as the precipitous cliffs. Likes to frequent caves and ruined buildings; is very common in Tibetan villages, and comes to cultivated fields. Feeds regularly in the village streets. Haunts the stone bridges across the streams. Nests in the Tibetan forts, such as those at Khampa, Tinki, and Shekar. One of the regular visitors to our base camp where it walked fearlessly amongst our tents like the pigeons in a city street. Also ascended to the higher camps. Made daily visits to Camp 1 at 18,000 feet, and seen sometimes at Camp 2 at 20,000 feet.

Columba leuconota leuconota. The Snow Pigeon.

Not seen on the plateau. Prefers to haunt precipitous cliffs. An inhabitant of the rocky gorges leading from the plateau into the main range. Seen in the Rongshar and Gautsa gorges between 12,000 and 13,500 feet.

Turtur orientalis. The Rufous Turtle-Dove.

Frequently observed in the Chumbi valley, usually amongst the trees at the edge of the torrent. Seen as high as Gautsa at 11,500 feet and at Chumbitang, 12,000 feet. A pair were observed on the plateau in a willow plantation at Tashidzong, 14,500 feet. This makes an addition to the birds mentioned in Wollaston's list. Norton in 1922 noted it as common in the lower Phung Chu, lower Dzakar Chu, Kharta and Kama valleys.

Syrrhaptes tibetanus. The Tibetan Sandgrouse.

Seen only at one place on the plateau, at Giri, 14,700 feet. Flocks were there common on the stony soil feeding along the margin of the stream. They harmonized well with their barren haunts.

Lophophorus impejanus. The Monal.

Seen in both the Chumbi and Rongshar valleys at about 12,000 feet.

Ithagenes cruentus. The Blood-Pheasant.

Seen on the descent from the Jelap La at 11,500 feet. Also in the Chumbi valley at 13,000 feet. Norton saw it at Sakyeteng in the Karma valley in 1922.

Perdix hodgsoniæ hodgsoniæ. The Tibetan Partridge.

Seen in pairs on the stony hills between 13,000 and 15,000 feet. Fairly common. Usually frequents the low scrub that collects around the base of some of the hills. Also enters cultivated fields. Longstaff in 1922 met with it on the Tinka La at 16,000 feet and at Kyishong 13,500 feet. Norton saw 'a lot with some half grown cheepers' in the lower Dzakar Chu valley on July 6.

Tetraogallus tibetanus. The East Tibetan Snow-Cock.

Snow-cock are amongst the common birds of the plateau. Their whistlings and chucklings are characteristic sounds. They frequent the barren stony hills where their plumage harmonizes well with the rock. Commonly seen near the summits of the passes up to 17,000 feet. In some places they are remarkably tame. We used to chase them on horseback and pelt them with stones. At our base camp in the Rongbuk valley they came within a few yards of our tents. Longstaff records it on Everest at 18,000 feet.

Megalornis nigricollis. The Black-necked Crane.

A pair were seen at Tingri on July 7, altitude 15,000 feet. In 1922 Longstaff and Norton saw and photographed a pair on the Tinki plain on June 15.

Cirripedesmus mongolicus atrifrons. The Central Asian Lesser Sand-Plover.

Seen in muddy river beds and along the banks of streams. Also in marshes and at edges of lakes. Fairly common on the plateau between 13,000 and 15,000 feet. In July a pair were nesting near Tingri at 16,000 feet. They adopted the usual ruse of the plovers. In a crouching attitude, with head bent almost to the ground, with tail expanded so as to display the white lateral feathers, wings drooping as if to simulate injury, the parent bird ran quickly through the short grass as if trying to lure the intruder away. Longstaff observed this plover in June on the Sepo La at 17,000 feet.

Ibidorhynchus struthersi. The Ibis Bill.

Not seen on the plateau. Frequents the streams in the mountain gorges that flow from the plateau into the main range. Met with in the Chumbi valley at 13,500 feet and in the Rongshar valley at 10,000 feet. Harmonizes most perfectly with the water-worn boulders amongst which it is accustomed to feed. Young were seen in June crouching amongst boulders on an island in the Rongshar stream. The reason why this bird has a bill with so peculiar a curve is disclosed by observing its behaviour. It runs about on the water-worn boulders, sometimes wading into the torrent up to its breast, thrusting its long bill under the round stones in the hope of finding insects beneath them. Sometimes it curves its bill around the front of the stone, sometimes inserts it from one side. The bill is an excellent instrument for this purpose. Were it straight it would not suit the roundness of the pebbles. Its peculiar curve is a necessary part of it, and is excellently adapted to the habits of the bird. For it is curved in such a way that it fits neatly around the boulders when the bird is probing for food.

Tringa ochropus. The Green Sandpiper.

Sandpipers were seen in the pools at Khampa Dzong, 14,000 feet. A few also in other parts of the plateau. I take it that they belonged to this species.

Totanus calidris. The Redshank.

Seen frequently in the plateau marshes between 14,000 and 15,000 feet. Nest composed of loose collection of sticks taken on July 12 at Jikkyop, 14,500 feet; contained four eggs almost hatched. Norton in 1922 met with families on July 15 near Lingka: one with four chicks of which the old birds very pluckily tried to attract him away from the brood.

Erolia temminckii. Temminck's Stint.

Noticed occasionally on the plateau. Flocks were seen on May 1, at Lingka, 14,500 feet. On May 23 a single bird came to a pool on the Rongbuk glacier at 17,000 feet. It seemed tired and was probably on migration.

Gallinago stenura. The Pin-tailed Snipe.

A snipe, flushed from marshy ground at Chodzong, 15,000 feet, probably belonged to this species.

Larus brunneicephalus. The Brown-headed Gull.

A common bird of the Tibetan plateau between 14,000 and 15,000 feet. Frequents lakes and swamps and running streams. Flocks may be seen resting on the ice in the morning waiting for the thaw to set in.

Sterna hirundo tibetana. The Tibetan Tern.

Abundant everywhere over streams and lakes between 13,000 and 15,000 feet. Frequently seen poising over and plunging into streams. Common around marshes and in the rocky gorge of the Dzakar Chu.

Anser indicus. The Bar-headed Goose.

Numerous on the plateau. Very tame. Allowed my approach to within 25 yards. Occupy all lakes and swamps, even the pools at the village walls. Well known to breed in Tibet. It is forbidden to take the eggs, yet one Tibetan official presented me with six. In 1922 goslings were observed by Longstaff on June 15. Norton records Tinki lake on July 14 as black with thousands of young birds.

Casarca ferruginea. The Ruddy Sheldrake.

Extremely common and remarkably tame. They are as fearless as the ducks in a London park. Seen on every lake and pool of the plateau between 13,000 and 15,000 feet. Usually in pairs, sometimes in small flocks, they feed with their heads deep in the water and tails high in the air. Sometimes a loud rushing noise is heard overhead which comes from a pair of sheldrake swooping down to occupy the pool. They also frequent the barren hillsides where they keep up a noisy courtship accompanied by bleating notes. It is interesting to observe their sexual enthusiasm, often at the edge of a frozen stream when the ground around them is draped in snow. Here is an example from a desolate valley in April at 14,000 feet. At the edge of the stream is an eager couple which give forth a kind of bleating note. The drake is the more ardent of the two and very persistent in his suit. From time to time he crouches low, stretches out his long goose-like neck, and makes a run towards his mate. At other times, when she is in the stream, he stretches out towards her, then utters his bleating note as if trying to call her to the bank. It is a cold desolation for such persistent enthusiasm which seems out of place amidst ice and snow. In June we saw many young on the Tingri lake ; others in July on the lakes at Tinki. Longstaff records it as a cliff breeder like Spitzbergen geese. He saw the first ducklings on June 10, which were gobbled by ravens on their journey to the river. Norton notes a fair number with families on Tinki lake, July 14.

Merganser orientalis. The Eastern Goosander.

At Kyishong, 14,500 feet, a pair seen in the river with five ducklings newly hatched.

THE RICE RATS OF LOWER SIND AND THEIR CONTROL

BY

P. V. WAGLE, M. AG.

(*With three diagrams and a plate*)

EDITED AND COMMUNICATED BY

DR. HAROLD H. MANN, DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY.

The Indus Delta in Sind is one of the most desolate pieces of country in the whole of India. With an uninteresting vegetation, a very small population, a very limited amount of cultivation compared with the vast areas available for the purpose, it is a dreary waste of waters in the inundation season, and a pastoral country utilized even for grazing only to a very small proportion of its possibilities, in the cold weather. The lack of development in this flat alluvial country in the rainy season is probably due to three chief causes,—the absence of control of the inundation water, the prevalence of intense malarial conditions, and the prevalence of field rats.

The prevalence of field rats is, in fact, one of the main causes of the limitation of cultivation, for the damage they do reduces the rice crop, which covers over 75 per cent of the cropped area, by an amount which varies in many areas from about 10 per cent to over 50 per cent of the crop. It is this which has led to the inquiry of which I propose to give an account in the present paper, as to the nature of the injurious field rats in this part of Lower Sind, and the methods which have proved successful in dealing with them.

Hitherto, the species of rat inhabiting this tract have hardly been known. In 1907, the late Mr. E. H. Aitken enumerated[1] the rats of Sind as follows :—" The commonest rat in Sind is probably the Jerboa rat (*Gerbillus indicus*) or its cousin the desert Gerbille (*Gerbillus hurrianeæ*).[2] Mr. Gleadow of the Forest Department was the discoverer of another species at Rohri, the little hairy-footed Gerbille (*Gerbillus gleadowi*).[3] The common house rat in Karachi at any rate, is pure white on the under parts, but brown rats are also found : both are ranked now as varieties of *Mus rattus*. . . . The short-tailed mole rat (*Nesokia hardwickei*) is widely spread in the Province and is ranked among the enemies of the farmer." In 1909, it is understood from a note by Mr. Kinnear in 1919, two examples of the Sind Mole rat (*Gunomys sindicus*) were sent to the Bombay Natural History Society, with a statement that this species was a regular plague. The inquiries made in 1924 and 1925, on the spot, indicate that three kinds of rat are very abundant in the Indus delta area of the Karachi district. These are (1) the well-known Gerbil (*Cheliones hurrianæ*) originally described from Hariana in the Punjab, but found in Baluchistan, in Rajputana (Kotah), in various parts of the Punjab (Attock, Delhi) and probably over the greater part of North-west India, (2) the Sind Mole-Rat *Gunomys sindicus*, originally described from Pithoro in Eastern Sind and authentic specimens of which have not been recorded from outside the province, (3) Hutton's Mole-Rat, *Nesokia huttoni*, originally described from Kandahar, but also recorded from Baluchistan, Quetta and Sukkur. Two of these species of rats are now proved to be quite innocent of damaging the rice crop, namely *Cheliones hurrianæ* and *Nesokia huttoni*, and the injury is almost entirely, if not entirely, due to *Gunomys sindicus*, the Sind Mole-Rat, which occurs in enormous numbers in the Indus delta. There is no doubt that, in the past, a great deal of energy and money has been spent in digging out and killing the wrong species of rat.

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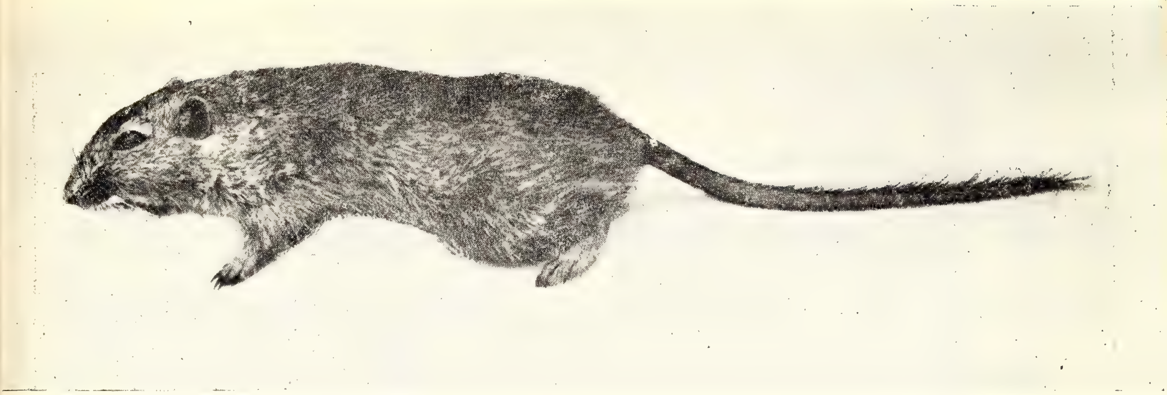
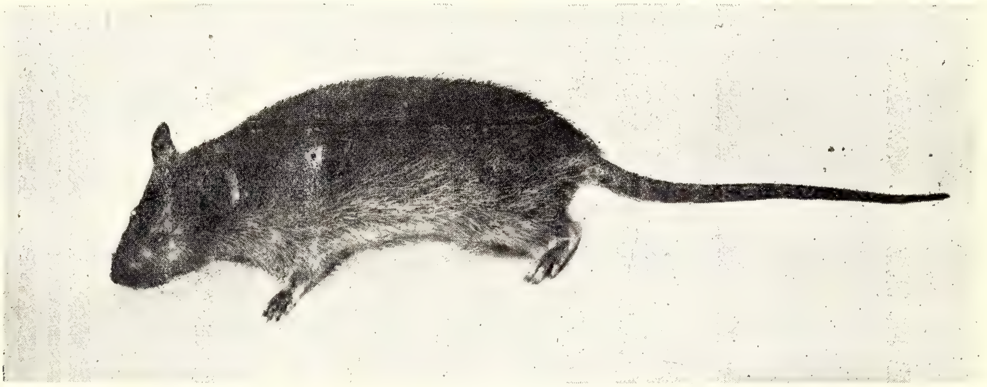
[1] *Sind Gazetteer* by E. H. Aitken, Karachi, 1907.

[2] Now known as *Cheliones hurrianæ*, Jerdon.

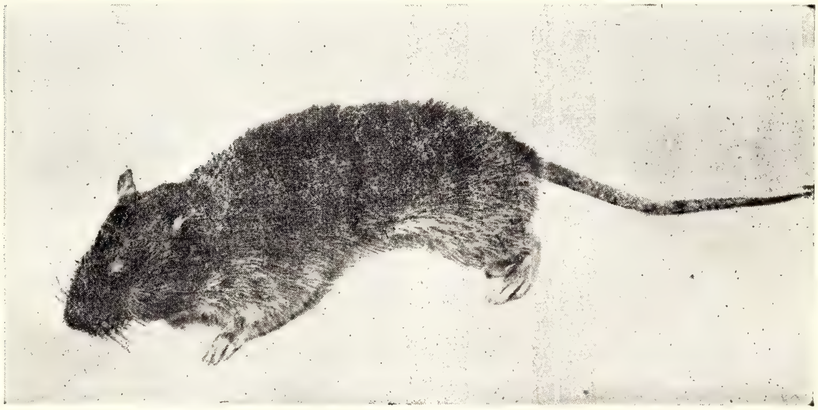
[3] Now known as *Nesokia indica*, G. & H.



THE INDIAN DESERT GERBIL (*Cheliones hurrianæ*).



THE SIND MOLE-RAT (*Gunomys sindicus*).



HUTTON'S MOLE-RAT (*Nesokia huttoni*).

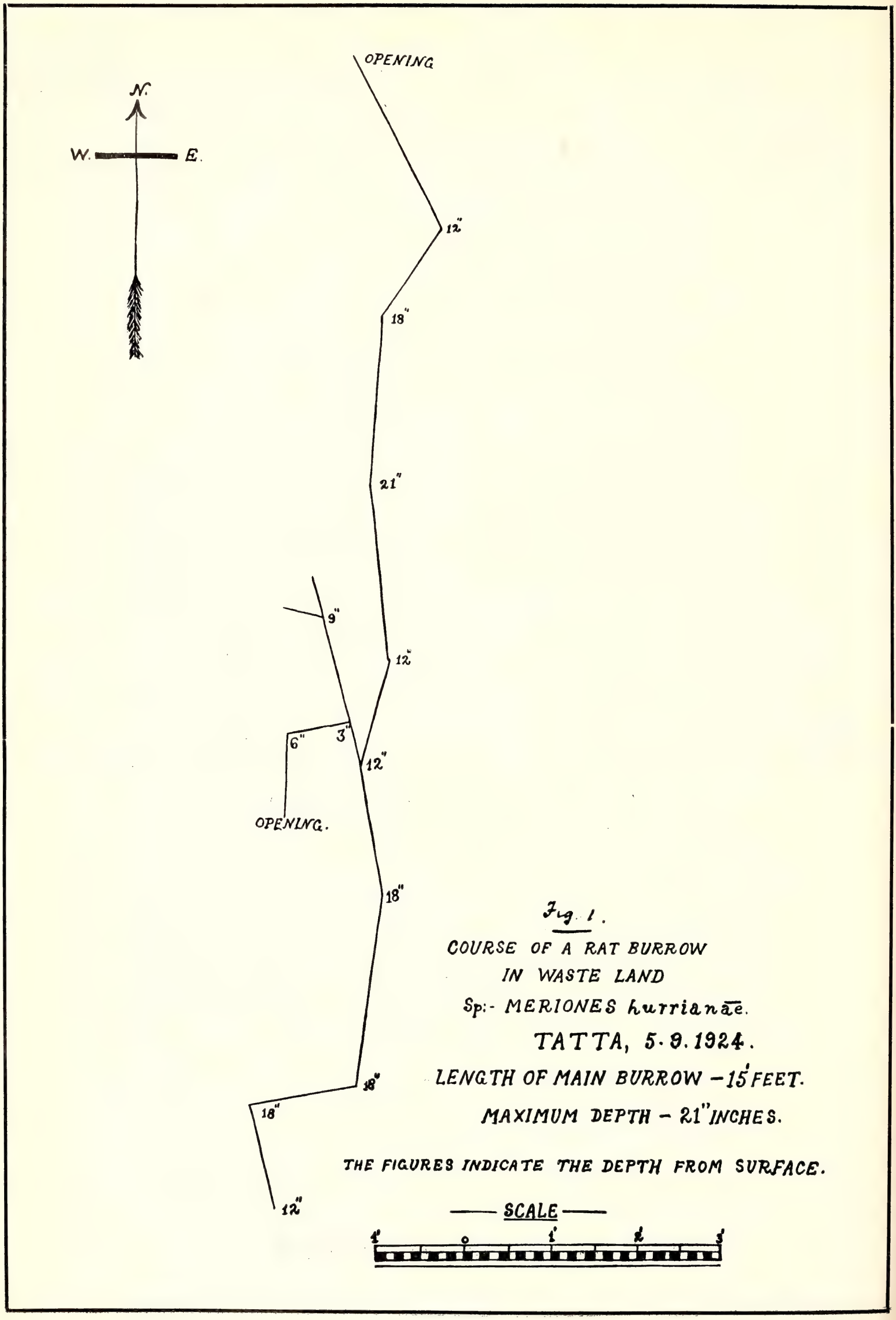

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Fig. 1.

COURSE OF A RAT BURROW
IN WASTE LAND
Sp:- MERIONES hurrianae.
TATTA, 5.9.1924.
LENGTH OF MAIN BURROW – 15' FEET.
MAXIMUM DEPTH – 21" INCHES.

THE FIGURES INDICATE THE DEPTH FROM SURFACE.

The Common Gerbil. *Cheliones hurrianæ.*

The common Gerbil, *Cheliones hurrianæ*, is the smallest of the three common rats of the area. Its range of length of the head and body is defined by Wroughton as 100 to 175 mm. Two adults gave the following actual measurements :—

	I mm.	II mm.
Head and Body length	105	108
Tail length	118	118
Length of Hind legs without claws	30	30
Ear length, from base	11	11

This species has very soft fur and is grey in colour, with very prominent black eyes. The ears are small and are covered with very fine soft fur. The tail long—longer than the head and body together—has a line of black hair on the dorsal side and ends in a brush of long black hair. The females have normally four pairs of mammæ two on the chest and two in the inguinal region. The adults weigh from two to three ounces.

The burrows of this rat are almost straight (*see* Fig. 1) with very little branching, and in this respect are very different from those of the other two rats to be described. They have usually two openings only, one at each end. In the burrows dug, no nest or anything of the kind was found in any one of them. The mouths of the burrows are always open and the inside is clear of loose earth.

The rats of this species feed entirely on the weeds growing round about their burrows, and they can be seen feeding in this manner even by day. They are never found in the rice fields, nor have stores of rice plants ever been found in their burrows. They are in fact, quite harmless from a farmer's point of view.

Hutton's Mole-Rat. *Nesokia huttoni.*

The other two common species of field rats in Lower Sind both belong to the sub-family *Murinæ*, or in other words to the large class of bandicoots. The genera *Gunomys* and *Nesokia* have only been recently separated on the basis (1) of the length of the palatal foramina,—this being long (8 mm.) in *Gunomys* and short (5 mm.) in *Nesokia*, and (2) of the number of mammæ, the genus *Gunomys* being multimammate (16 to 18 mammæ) while *Nesokia* has only 8 mammæ. Both are mole rats living normally underground, but the species occurring in Sind have very different habits.

Hutton's Mole Rat, *Nesokia huttoni*, is smaller than the Sind Mole-Rat (*Gunomys sindicus*) to be described later. Its range of length of the head and body is defined by Wroughton as being under 225 mm. but actual samples found in Sind are far smaller than this. Two adults gave the following measurements :—

	I mm.	II mm.
Head and Body length	135	155
Tail length	90	112
Length of Hind Leg without claws	29	29
Ear length, from base	26	17

This species has very soft fur, and is ochraceous in colour fading to greyish-white on the belly. The fore and hind legs and tail are flesh coloured. The ears are fairly small and almost naked. The tail is short not more, or only very slightly more, than two-thirds of the length of head and body together. It is slender and covered with minute hairs. The adults weigh about four ounces. The number of young per litter does not, in our experience, exceed eight.

In disposition, the rats of this species are very variable. When kept in captivity some individuals are violent and bite at all parts of the cage in which they are confined, while others are quiet and submissive.

The burrows of this species are found in and round moist grassy areas during the dry weather and in the embankments of rice fields during the inundation season extending into the rice fields themselves as the water retires. They are very long (*see* Fig. 2) sometimes extending to forty or fifty feet. They are very much branched, but the communication between the branches and the original burrow is generally closed. They have usually two to three openings all of which are closed with heaps of loose soil throughout the year. The inside of the burrows is not very clean, loose soil lying about everywhere. Sometimes the passage of the burrow is so completely packed up with soil that it is hard even to trace out its course. Nests are found in the burrows. When the water either in swampy areas or in rice fields dries up, the rats extend their burrows into these areas and use them until the next inundation compels them to withdraw to the portions in the higher ground. When the burrows are opened up, the rats, *Nesokia huttoni*, stick to them to the last and do not run away.

Rats of this species usually do not leave the burrows for quite long periods, and feed on the roots of grasses, *from the inside of the burrows*. The lines of the burrows can in fact often be followed in grass areas, from above ground by the withering of lines of grasses whose roots have been eaten. Their principal food appears to consist of the roots of *dab* grass (*Eragrostis cynosurioides*) as has been ascertained both by examination of their stomach contents and of the grass above their burrows. The search for the roots they require for food accounts for the great length of their burrows.

THE SIND MOLE-RAT. *Gunomys sindicus*.

The Sind Mole-Rat, *Gunomys sindicus*, which is the really serious injurious field rat in Lower Sind, is altogether a larger animal than either of the two others already described. Its range of length of the head and body is defined by Wroughton as being less than 200 mm., and adult examples actually measured in Sind gave the following figures :—

	I mm.	II mm.
Head and Body length	190	198
Tail length	160	165
Length of Hind Legs without claws	37	34
Ear length, from base	24	24

This species has coarse and harsh fur, intermixed with a certain number of longer and coarser hairs scattered over the back and flanks. The colour is very variable, but the general appearance above is of mingled buff and black, fading into greyish-white on the belly. The fore and hind legs and tail are flesh coloured. The ears are large and appear almost naked, though they are really covered with very fine soft fur. The tail is long, slender and almost naked. The minute hairs with which it is clothed are visible with difficulty.

The females have normally eight pairs of mammæ, two pairs on the chest, two pairs on the inguinal region, and the remaining four pairs on the sides of the abdomen. But variations in the number and arrangement frequently occur. The number varies from fourteen to eighteen, and these are not always arranged in pairs, there being often two to three more teats on the left side than on the right.

Full-sized adults weigh about eight ounces. The rats of this species breed throughout the year. In October and November, however, the litters are very large, varying from fourteen to eighteen per litter. During the rest of the year, the number varies from five to ten. The young, when just born, are 35 mm. in length (head and body) and weigh from three to five grammes. They are born blind and naked, and are pink in colour. The eyes open after about a fortnight, and the young begin freely to leave the nest after about a month. Young rats of this species up to 134 mm. in length (head and body) have been sometimes found with the mother, and sometimes living independently.

The Sind Mole-Rats are very active and difficult to catch, and are fierce and have been even known to attack a man. They can usually be kept in confinement and will breed under these conditions. Though normally living underground they are neat and cleanly in their habits, cleaning dirt from their fur with the fore feet and tongue.

The burrows of *Gunomys sindicus* are found in exactly similar situations to those already described for Hutton's Mole-Rat, but they are much more migratory than the latter. It may be stated that the normal living and breeding places are round the edges of grassy areas which are flooded during the inundation season, known as *dhands* in Sind. The openings of the burrows are usually situated under bushes or in high grass. In July or August, when

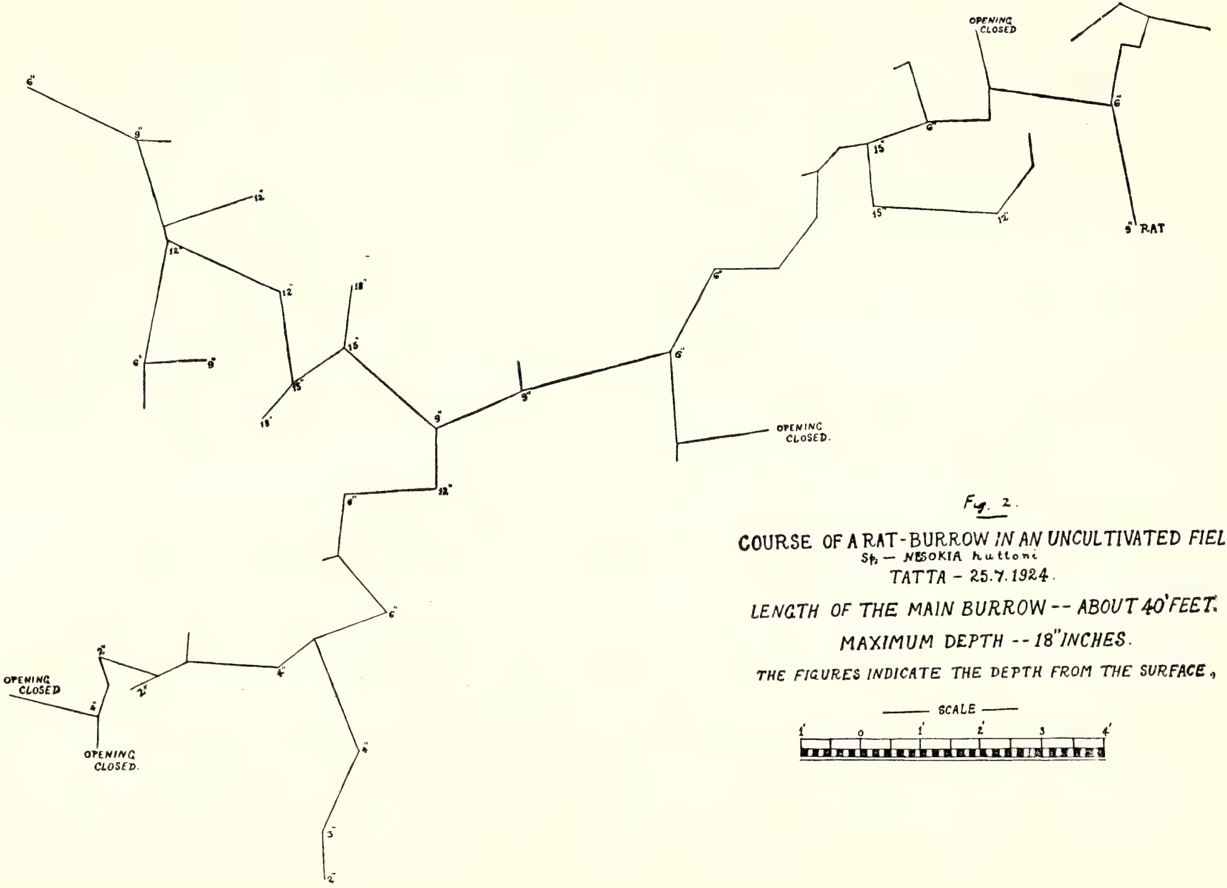

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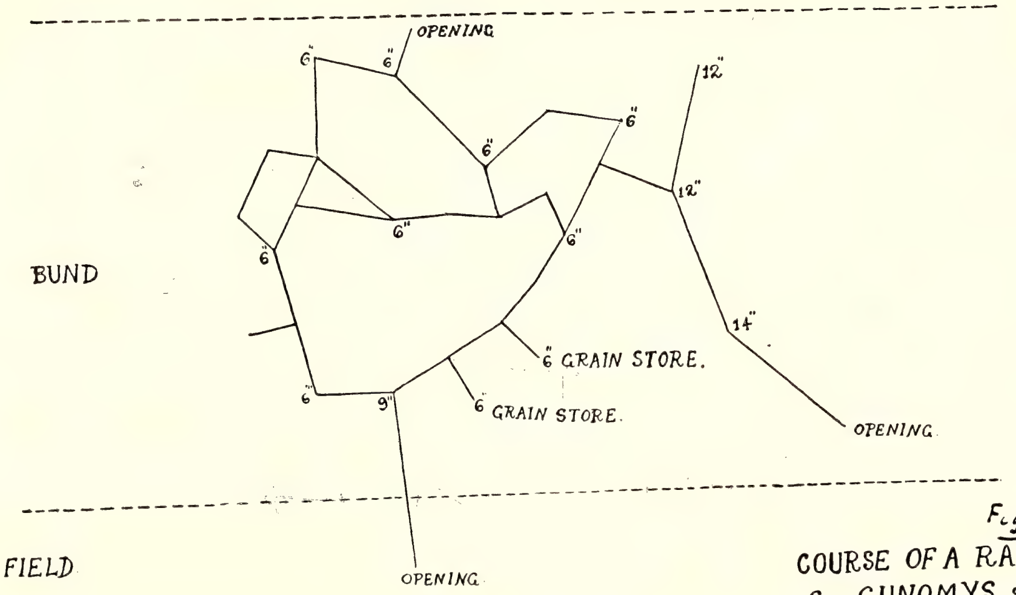
Fig. 2.

COURSE OF A RAT-BURROW IN AN UNCULTIVATED FIELD.
Sp. — NESOKIA huttoni
TATTA – 25.7.1924.

LENGTH OF THE MAIN BURROW -- ABOUT 40' FEET.

MAXIMUM DEPTH -- 18" INCHES.

THE FIGURES INDICATE THE DEPTH FROM THE SURFACE.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6"
BUND
14"
6" GRAIN STORE.
6"
9"
6" GRAIN STORE.
OPENING
FIELD
OPENING

Fig. 3.

COURSE OF A RAT-BURROW IN BUND.
Sp. GUNOMYS sindicus.
HALAYA. 3.11.1924.
LENGTH OF THE MAIN BURROW – 13' FEET, 9" INCHES.
MAXIMUM DEPTH – 14" INCHES.

THE FIGURES INDICATE THE DEPTH FROM THE SURFACE.

—— SCALE. ——

1'
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2'
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the lower lands are flooded and the rice crops offer attractive food, they leave these grassy areas and turn their attention to the embankments of the rice fields. To these rice areas they keep pouring in throughout the season, and there is always more damage from rats in the areas which abound with *dhands*. When the water falls in the rice fields they extend their burrows into the fields themselves,—and after the crop is harvested and the rice which they have stored is exhausted, they again migrate to the grassy areas, often to considerable distances.

The burrows in the rice areas occur, therefore, both in the embankments and in the fields, but when there is water standing in the fields, they restrict themselves to the embankments. When both the fields and the embankments are submerged, as occasionally happens, they form nests on the tops of the rice plants above the water, but whether these are merely temporary resting places is not known.

The burrows of this species are short, but connect extensively with one another (*see* Fig. 3), especially when the rats live within the embankments. They then occupy a length of two to ten feet. Each burrow has three to four openings, which are generally found open, and a large heap of soil is found outside one or two of the openings. Balls of excreta are found mixed with these heaps of soil. There is no loose soil lying anywhere in the burrow. When the soil is very wet, and when there is plenty of grass or rice growing, the rats construct, inside their burrows, two or three nests either of grass or rice straw. Outside the burrow, distinct runways through dense vegetation to the feeding grounds of the rats are frequently found and it is under such safe cover that they move about in search of food. Though the rats of this species are nocturnal in their habits, yet they can sometimes be seen outside by day, especially at harvest time, under cover of grass.

When the water in the rice fields dries up, the rats leave their burrows in the embankments and dig fresh burrows in the fields themselves. Such burrows are longer than those in the embankments, and in these they store grain, sometimes along the main burrow, and sometimes in special chambers. After this store is finished, the general migration from the rice areas to the grassy lands (*dhands*) begins, where they dig fresh burrows, and these they occupy until the next inundation season.

Though the Sind Mole-rat lives normally in dry land, it is capable of swimming. Medium-sized adults when kept in water twelve inches deep in glass jars were able to maintain themselves without any support from forty to sixty hours. They are always able to dive, and in face of any danger they jump into water and dive or swim away. A high flood, however, destroys enormous numbers of these rats, and is probably the main natural agency in keeping down their numbers.

FOOD AND HABITS OF THE SIND MOLE-RAT

In nature, the Sind Mole-rats have been noted to feed on two different classes of material. On the one hand they take, when they can obtain them, rice plants in various stages, and the earheads of the *bajri* crop (*Pennisetum typhoideum*) : on the other hand they eat the roots and tubers of certain grasses and sedges.

So far as the rice plant is concerned, it is eaten chiefly in three stages. In August when the crop has grown to a height of eighteen inches to two feet, the rats cut off the plants at the bottom, to feed on the lower sweet pulpy portion of the stem. It is in these days that the rats, probably for the purpose of being near enough to their food supply, construct temporary nests on the top of the rice plants—especially in submerged fields—made of rice plants cut and twisted together. The damage to the rice fields at this stage is generally in the form of patches all over the fields, and in years of rat plagues these patches extend over large areas. Usually the damage is not so serious as it looks, as tillering takes place, and the plants still mature though a little later than the general crop.

The second stage of the growth of the rice plant when it appears particularly attractive to the Sind Mole-rat is when the grain in the earheads is soft and milky. The rats then either climb up the rice plants or bend them over, and suck the milky pulp from the earheads which consequently dry up. A far more serious type of damage is done, however, in the third stage when the grain has fully ripened. The rats then eat the grain, leaving only the outer hulls, and in order to do so they cut off the earheads and store them in large quantities in their burrows. The burrows, in fact, if dug at this time of year (October or November) show large numbers of earheads stored, sometimes in special chambers and sometimes in the main burrows. More than six hundred earheads were counted in some of the burrows, and even then, more were being collected. Much is eaten, much is wasted, and the store is used up, ordinarily, by December in each year. This cutting off, storing, and eating the mature or nearly mature earheads represents the chief damage done by the rats. In 1925, a large number of fields in the Tatta, Sujawal and Shah Bunder talukas of the Karachi District were examined, and about 12½ per cent of the earheads had been removed in this manner. This was not a 'plague year' but probably represents the normal amount of damage in much of the Indus Delta. If we take it as such, and count a normal crop as 1,000 lbs. per acre of paddy, worth 25 lbs. per rupee—this damage would mean over twenty-three lakhs of rupees damage per annum.

Other *crops* are only eaten to a limited extent. *Bajri* grown in the inundation season, and wheat grown in the cold weather are also taken in some years, but not to anything like the same extent. Oilseeds (rape, mustard, etc.) and pulses grown in the cold weather are almost free from the trouble.

The other main food of the Sind Mole-rat, used chiefly during its annual sojourn in the grassy areas, consists of the roots and tubers of certain grasses and sedges, which are exceedingly common there. The chief of these are (1) the roots of *dab* grass (*Eragrostis cynosurioides*) (2) the roots and tubers of *dheer* (*Scirpus subulatus*) and *kal* (*Scirpus maritimus*). These materials supply the chief food during the portion of the year when rice is not available.

In order to try and find the real preferences of the Sind Mole-rat, in the matter of food, a number of adult rats were kept in cages and fed on various materials. Small to medium-sized adults or nearly adult rats, weighing from four to five ounces each were taken, and kept for two days or so in the cages to accustom them to the surroundings with a sufficient supply of water. Weighed quantities of various foods were placed in the cages, and the amount left after 24 hours was again weighed. The difference between the amount given, and the amount remaining after 24 hours, indicated the amount consumed by the rat. A number of tests were made with each kind of material. Healthy rats only were employed: if they became sick, they were not used again.

The average quantity consumed in 24 hours by small to medium-sized rats was as follows:—

Green Bananas	10·7 gms.	
Ripe Bananas	22·0 ,,	
Green *guvar*[1] pods	1·3 ,,	
Turi (*Lufa acutangula*)	25·3 ,,	
Roots of *dab* grass	10·9 ,,	
Uncooked wheat flour wetted with water ...	9·0 ,,	
Cooked wheat flour wetted with water ...	14·0 ,,	
Uncooked wetted *bajri* flour	9·6 ,,	
Cooked wetted *bajri* flour	13·1 ,,	
Uncooked wetted rice flour	12·5 ,,	
Cooked wetted rice flour	15·0 ,,	
Uncooked wetted *gram*[2] flour	4·0 ,,	
Cooked wetted *gram* flour	14·2 ,,	
Uncooked wetted wheat bran	8·6 ,,	
Cooked wetted wheat bran	10·9 ,,	
Dry gram	1·7 ,,	
Gram soaked in water for 24 hours ...	8·1 ,,	
Earheads of rice	6·7 ,,	leaving all (hulls)
Earheads of *Bajri*	10·3 ,,	
Earheads of *Jowar* (*Sorghum*)	5·8 ,,	
Dry Copra (Cocoanut)	1·1 ,,	
Dry Fish	Nil	
Green rice plants	6·6 ,,	(only the lower portion of stems eaten)

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[1] Guvar, *Cyamopsis psoralioides*.

[2] Gram, *Cicer arietinum*.

Some of the tests were repeated with larger rats (6 ounces), but using the same method. The result was as follows :—

Roots of *dab* grass	24·4 gms.
Tubers of *kal* (*Scirpus maritimus*)	42·7 ,,
Unhusked rice	14·9 ,, (leaving all hulls)
Uncooked *bajri* flour	10·8 gms.
Cooked *bajri* flour	34·4 ,,
Dry whole wheat	4·0 ,,
Dry crushed wheat	8·3 ,,
Crushed wheat, wetted with 25 per cent water	12·8 gms. (dry wheat).

It will be noticed from all these figures that the roots and tubers of grasses are very highly relished, that grain flours of all kinds are eaten readily, and are preferred when cooked and that rice is only eaten after removing the hulls. Plantains are very much relished, but green *guvar* pods are not liked. Fish is not touched at all. Only the lower portions of the stems of green rice plants were eaten.

As it was desirable to know whether foods could be made more attractive, some of these foods were mixed with *gul* (raw sugar), with cocoanut oil, and with aniseed oil. These were all mixed with rice flour, or wheat bran,—but in no case did the addition cause the rats to consume more of the food used. The following figures indicate the results :—

Quantity consumed by one rat in 24 hours.

1	(*a*)	Uncooked rice alone	12·5 gms.
	(*b*)	Uncooked rice with *gul*	8·4 ,,
2	(*a*)	Cooked wheat bran alone	10·9 ,,
	(*b*)	Cooked wheat bran with *gul*	9·0 ,,
3	(*a*)	Uncooked rice flour alone	12·5 ,,
	(*b*)	Uncooked rice flour, with cocoanut oil	10·4 ,,
4	(*a*)	Uncooked rice flour alone	12·5 ,,
	(*b*)	Uncooked rice flour with aniseed oil	10·0 ,,

Methods of Control of the Sind Mole-Rat

In Lower Sind, the Sind Mole-rats always do extensive though variable damage. Some years they are a veritable plague and in most seasons, this is the case in some parts of the area. Probably the main natural means of control is the prevalence of floods. Though these rats are good swimmers, yet a high flood by filling their burrows with water, does destroy a large number for in these times it is only the very high land which remains as a refuge. The fact of the variability of the damage from year to year, apparently without reason, leads to the idea that a rat plague is a scourge of God against which little or nothing can be done. This idea prevails very widely among the cultivators of the Indus Delta.

When the pest becomes really serious, many people *do*, however, have recourse to digging out the rats in the embankments and there are even special rat *shikaris* employed, who are very skilful in digging out and killing rats. The Sind Mole-rat is somewhat difficult to deal with, as it is easily alarmed and runs away at the least provocation. But the *shikaris*, who have made this their profession, are able, in bad attacks, to catch and kill sixty or seventy rats per day, and are paid eight to twelve annas per hundred rat-tails produced. As the number of rats decreases, the rate of pay rises, till it may go up to Rs. 2 to Rs. 3 per hundred tails.

A method of digging has been recently adopted in the Tatta taluka, by which all openings of the burrow were closed except one, and a fishing net was placed over the remaining opening. As the *Gunomys* rat is easily alarmed, it flees when digging is begun, and is caught and killed in the net. Dogs are some times used, too, in connection with digging.

But, at the best, the digging out of rat holes is an expensive and unsatisfactory method. Long burrows are usually avoided by the *shikaris*, as being too much trouble. The embankments are often badly spoiled by the digging operations and cost a good deal to repair. Many of the rats killed are the harmless *Nesokia* *huttoni* instead of the injurious *Gunomys sindicus*. And, as new rats are continually moving into the rice area, a few field may easily be re-infected after all the trouble has been taken.

Two methods of destroying the Sind Mole-rat on a large scale have been tried. The first has been by poisoning, which has not proved applicable on a large scale : the second is by fumigation of the burrows which under conditions which can now be defined, seems to be practicable and efficient as a method of controlling the rats.

CONTROL BY POISON BAITS

In the experiments on poisoning, the best medium for conveying the poison was found to be cooked *bajri* flour. This was as attractive as any available material, and was mixed with (1) strychnine hydrochloride, (2) barium carbonate, (3) white arsenic, (4) plaster of Paris, and (5) a proprietary phosphorus preparation known as 'Farmers' Vermin Destroyer'. The last two of these proved entirely useless : On the other hand, effective results were obtained with the other poisons.

With strychnine hydrochloride, one rat died within half an hour after taking cooked *bajri* flour containing 0·025 grains of the poison : another died within 12 hours after taking bait containing 0·12 grains of the poison. With barium carbonate the minimum effective dose was 1·0 grain of the poison, contained in 5 grammes of *bajri* flour. In this case the rat died within 12 hours. Using white arsenic, cooked *bajri* flour containing 0·05 grains of the poison was effective within 12 hours.

All the above tests were made with 4 to 5 ounce adult rats. Further trials were then made with larger rats weighing 6 ounces. Again strychnine hydrochloride was found to be effective within 12 hours when the rat consumed *bajri* flour containing 0·1 grain of the poison. Barium carbonate caused the death of the rat within 48 hours when flour containing 1·2 grains of the poison was taken, and within 15 hours when 2·4 grains of the poison was consumed. In the case of white arsenic, 0·2 grains of the poison killed the rat in 36 hours and 0·5 grains in 12 hours.

When tested in the field the following method was adopted : Baits of cooked *bajri* flour or other media, 5 to 8 grammes in weight were mixed with adequate doses of the poison and placed near one of the openings of the burrows in the evening. They were examined next morning, and when the baits had been touched, the burrows were dug out to see whether the rat was dead. Four cases occur.

1. The bait had been partly or wholly eaten, and on excavation a dead rat was found in the burrow.
2. The bait had been partly or wholly eaten, and on excavation no rat was found in the burrow.
3. The bait was untouched, and no sign of a rat's activities.
4. The bait was untouched, but had been dragged inside the burrow, and there was only a living rat in the burrow.

The first case means success : the second has been counted as success, for it is probable that the rat had died away from the burrow : in the third case the burrow is evidently uninhabited and so these cases are excluded from the list of tests made : and in the last case, the rat refused the bait or was unaffected by it, and the result was a failure. The percentage of success was calculated by the proportion of cases 1 and 2 to the total of cases 1, 2 and 4.

The results with barium carbonate and white arsenic were extremely poor, as follows :—

A.—*Barium Carbonate* (3 to 4 grains per bait).

1.	December 1924.	*Medium*-Cooked *bajri* flour (16 baits) ...	12 5 per cent successful.
2.	February 1925.	*Medium*-crushed wheat (25 baits) ...	12·0 ,,

B.—*White Arsenic* (1 grain per bait).

1.	January 1925.	*Medium*-cooked *bajri* flour (30 baits) ...	43 ,,
2.	February 1925.	*Medium* crushed wheat (40 baits) ...	10 ,,

Strychnine hydrochloride was much more effective, as follows :—

C.—*Strychnine hydrochloride* (0·3 to 0·5 grain per bait).

1.	December 1924.	*Medium*-cooked *bajri* flour (14 baits) ...	43 per cent. successful.
2.	December 1924.	*Medium*, whole wheat (45 baits) ...	67 ,,
3.	January 1925.	*Medium*-crushed wheat (40 baits) ...	60 ,,
4.	February 1925.	*Medium*-crushed wheat (57 baits) ...	39 ,,
5	March 1925.	*Medium*-crushed wheat (23 baits) ...	22 ,,
6.	March 1925.	*Medium*-boiled rice (20 baits) ...	20 ,,

Even in the case of the last poison, the results are not, however, very promising. With a migrating pest like the Sind Mole-rat, partial destruction of the pest in this manner is hardly what is wanted, and as attempts at fumigation had more promise, further attempts in the direction of using poison baits were given up.

Control by Fumigation

As it was shown in the early part of this investigation that the burrows of the Sind Mole-rat, as they are found in the embankments of the rice fields during the inundation season, are comparatively short and free from obstructions, there seemed a possibility that the rats could be killed by fumigating the burrows with lethal gases. Previous attempts using carbon bisulphide vapour as the fumigant, in the longer burrows found in the cold weather (November and December 1920) had proved very ineffective, but as soon as it was realized that the only time for fumigating the burrows was during the inundation season, almost complete success was obtained.

The method used was first to pump smoke (made by the mixed vapours of hydrochloric acid and ammonia) into a burrow, close all openings where smoke comes out, by soil,—and then pump in the fumigant. The machine used for the purpose was the '*Suddeth Rabbit Fumigator*' obtained from Australia. Carbon bisulphide or petrol, or a mixture of the two was used as a fumigant in all these tests in 1925. The amount used varied from one pound per nine burrows, to one pound per 40 burrows, and the latter quantity was found quite effective *at the proper season*. The actual quantities used and the percentage of success was as follows :—

Date	Fumigant	Number of Burrows per 1 lb. of fumigant	Percentage of success per cent
August 1925	Carbon bisulphide	9	100
,,	,,	20	100
,,	,,	40	100
September 1925	,,	40	100
October 1925	,,	40	100
November 1925	,,	40	25
December 1925	,,	23	33
January 1926	,,	20	30
October 1925	Petrol	30	18
November 1925	,,	15	Nil.
October 1925	Petrol and Carbon bisulphide (1 : 1)	15	83
November 1925	,, (2 : 1)	34	32
December 1925	,,	15	8

The results seem clear. Up to October, carbon bisulphide seems a perfectly effective fumigant, when applied at the rate of one pound per 40 burrows.

An attempt was made to apply this method of fumigation with carbon bisulphide in 1925 on an area of 250 acres in a badly affected area in the Shah Bunder taluka, during the inundation season. The rats were found chiefly in the embankments, which were covered with thick tall grass—thus causing considerable difficulty in finding the burrows. The area was gone over with the machine,—smoke followed by fumigant,—and all the rats destroyed, as was made clear by digging out a number of the burrows. Then the embankments were re-infested with rats from the outside, and the treatment was repeated. The whole area was in fact, gone over four or five times, and 2,500 rats were destroyed. The cost for material came from 8 to 10 annas per acre.

When the experiments had reached this stage, I was compelled to leave Sind and further work was placed in other hands. I have been allowed, however, to utilize the results obtained in 1926,—when the work of rat extermination was carried out on a much larger scale, and a new method of fumigation introduced, which bids fair to give more widely applicable results than those previously described.

The results of 1925 had, however, been so promising that it was decided to deal with about 3,200 acres of badly affected country in 1926. It was clear that if fumigation was to be successful, it would have to be done between August and October, whatever fumigant was used. It was originally intended that carbon bisulphide should be exclusively used for the purpose, but just when the work was about to begin, attention was drawn to the probability that even better results might be obtained by the use of calcium cyanide in very fine dust, which could be pumped into the burrows exactly like a vapour. This material is now available in large quantities at a moderate price, and suitable cheap pumps for blowing the dust into the burrows are also obtainable. Preliminary experiments, near, Tatta, were, in fact, so promising that it was determined to use this material on a large scale.

In carrying out these large scale tests, two centres were taken in both of which the rat attack promised to be very serious in 1926, and altogether 3,463 acres were treated either with carbon bisulphide or with calcium cyanide dust (A dust). All the land was gone over three times, and 423 acres in Tando Mahomed Khan was gone over four times. The total quantity of carbon bisulphide used was 1 lb. 10 ozs. per 100 burrows and of calcium cyanide dust was half a pound per 100 burrows.

The following table shows the details of the treatment. It may be noted that the carbon bisulphide costs Rs. 2-8-0 per pound, and the calcium cyanide dust Rs. 1-8-0 per pound. Both these prices would be very much reduced if the use of the method became general.

Place	Material used	Area treated in acres	No. of burrows treated	Cost of material & labour per acre. Rs.	Total cost per acre Rs.
1. Shahbunder.	Carbon bisulphide	720	12,431	1 1 0	2 2 0
2. Shahbunder.	Calcium cyanide dust.	1,040	24,960	0 6 0	0 12 0
3. Tando Mahomed Khan	Carbon bisulphide.	423	12,089	1 11 1	3 6 2
4. Tando Mahomed Khan	Calcium cyanide dust.	1,280	22,874	0 5 8	0 11 4

The treatment was completely successful with both materials, but the use of Calcium cyanide dust is not only much cheaper, but also is much simple to apply. It appears clear, in fact, that by an expenditure not exceeding 12 annas per acre, this rat pest, which as has been shown above, causes an annual loss of crop which amounts to between twenty and thirty lakhs of rupees, can be controlled.

GAME PRESERVATION IN THE NILGIRIS

BY

MAJOR E. G. PHYTHIAN-ADAMS, I.A. (RETD.)

The Nilgiri Game Association was formed in 1879, and is therefore one of the oldest societies for Game Preservation in India.

The area under its control includes not only the whole of the Nilgiri District, but also parts of Coimbatore and Malabar. A detailed physical description of the country is unnecessary, and it will suffice to divide it into (1) upland; (2) slopes; and (3) low country. (1) The upland consists of the Nilgiri plateau at an average elevation of 6,500′, open rolling downs alternating with wooded sholas often of considerable extent. (2) The slopes, generally grassy or with light jungle, run down more or less precipitously to the low country. On the west are the famous cliffs of the Kundahs. (3) The low country includes the Nilgiri Wynaad at an average elevation of 3,000′ and the area between the slopes and the Moyar and Bhavani rivers running down to little more than 1,000′ above sea-level. The jungle varies from heavy tree to light thorny scrub.

The mass of the Nilgiri plateau intercepts the monsoon currents and accordingly one side receives heavy rain from the south-west monsoon while the other obtains little except from the north-east. This climatic variation considerably affects both the nesting seasons of birds and the times when the deer, more especially chital, may be found in hard horn. At the time of the formation of the Association in 1879 as the result of considerable Press agitation, big game was fast approaching extinction on the plateau. The butchers of that period knew no restriction of age, sex, or season, and slaughtered alike does, fawns, and stags in velvet. To anyone who thinks this picture overdrawn, a persual is recommended of the articles entitled 'Game,' published in the *South Indian Observer* in 1876, by 'Hawkeye,' the late General Hamilton, to whom the thanks of all sportsmen are due. Owing largely to his efforts, the Madras Government passed 'the Nilgiris Game and Fish Preservation Act of 1879,' which with minor modifications has been in force ever since.

The Act provides for close seasons, protection of females and immature animals, etc., on Government lands only, and vests in the Collector of the District very considerable powers regarding the conditions under which a licence to shoot may be issued. The Collector is assisted by the D. F. O. as Honorary Secretary, and by the Committee of the N. G. A. At the present time a season shooting licence costs Rs. 50, and entitles the holder to shoot the following head of mature game :—

Sambur	2	Jungle-sheep	6
Spotted deer	3	Ibex	1
Blackbuck	1	Bison	1
		Four-horned antelope	1

while a monthly licence costing Rs. 30 entitles the holder to :—

Sambur	1	Bison or Ibex	1
Spotted deer	1	Blackbuck or four-horned antelope	1
Jungle-sheep	3		

Mature heads are defined as :—

Sambur	30″	Spotted deer	28″
Blackbuck	14″	Ibex	13″

Bison 33″ span, or 18″ girth, or 4″ of corrugation.

Stringent penalties are imposed for shooting females or immature heads. All fines however have to be credited to Government, and are not allowed to swell the funds of the N. G. A.

The close season runs from July 1 to October 31 for big game, and from March 1 to September 15 for small game; there is no separate licence for the latter. On an average about eighty season and twenty monthly licences are issued. Visitors pay the same fees as residents.

Taking in order the various big game of the area :—

(1) *Sambur.*—Are now numerous all over the plateau, slopes, and low country, but really good heads are very scarce, and even those considered shootable (30″) are not numerous. The hinds outnumber the stags on an average by eight to one, and need thinning, but the difficulties in the way of this are obvious. The total absence of lime on the Nilgiris is no doubt chiefly to blame for the small size of the heads but another contributing cause is undoubtedly the shooting off of the best stags year after year, leaving to breed chiefly immature animals and those past their prime. All old stags 'going back' should be shot off.

The record head for the Nilgiris is only 42″ shot many years ago, and it does not appear that one over 38″ has been obtained for some time. During the past six years an average of twenty-eight stags has been shot annually.

(2) *Spotted Deer.*—Very numerous in the low country, but much persecuted by wild dogs and by patta-land shooters. The heads are good running up to 38″, but are generally thinner than those in the C. P. The average for the last six years is twenty-seven buck annually.

(3) *Bison.*—Have increased considerably in the low country, some of the herds numbering up to thirty. Good heads are however scarce and the average number shot in the last six years is only seven annually, the best recorded head having a span of 41″.

(4) *Ibex.*—Nilgiri Tahr, locally known as Ibex, were nearly extinct in 1879 but thanks to careful protection have now increased very considerably, and the total of the herds in the Kundahs cannot now fall much short of 400. In 1925 the writer saw a single herd of over eighty, nearly half of which were kids. After such a long

period of protection it might be expected that the old bucks (saddle-backs) would carry fine heads, but of the *total* of eight shot in the last six years, the best measures only 15¼″. The does outnumber the bucks by some 20 to 1, and there is no satisfactory explanation for such disproportion. Ibex suffer considerably from the depredations of panthers and, though to a less degree, from poaching Kurrumbas on the Bhavani slopes.

(5) *Blackbuck.*—Were closed to shooting from 1923 to 1926 and are still not numerous, but sufficiently so to allow the inclusion of one on the licence for those who care to shoot so poor a trophy. They seldom measure over 17″ and are considerably smaller in build than up-country buck.

(6) *Jungle-sheep.*—As the Muntjac is locally called—are sufficiently numerous and call for no remarks. Fifty-two are shot annually on an average.

(7) *Four-horned Antelope.*—Are scarce, and only four have been shot in the last six years. It may be of interest to note that the variety with two horns only is generally found here. In old books it is termed the 'Mountain Antelope.'

(8) *Nilghai.*—Are rare in the area and are strictly protected.

(9) *Tiger, Panther and Bear.*—Are not protected and call for few remarks. The average numbers shot annually during the past six years were 13, 29 and 6 respectively. Chance-met tigers occur more frequently on the plateau than in most other parts of India. The writer had the good fortune to meet a family party of three on the main bridle-path in the Kundahs on November 1 last, and the late General Hamilton once saw no less than five together in the same locality.

The destruction of panthers has resulted in a great increase in the numbers of wild pig which did so much damage to cultivation that in 1921 Government found it necessary to give a reward for their destruction. After some 1,350 had been killed the reward was stopped in 1924.

(10) *Wild Dogs.*—Though not strictly speaking game, these play an important part in Game Preservation. Up till 1923 a reward of Rs. 25 was paid for every wild dog killed in the area, of which the N. G. A. gave Rs. 15, Government contributing the balance. The results were satisfactory in that some forty to fifty were destroyed annually. Unfortunately the adjoining districts did not co-operate, and skins of dogs shot outside the area were brought in in such increasing numbers that the N. G. A. in 1923 were forced from lack of funds to discontinue the reward. At the same time Government in a fit of economy stopped their contribution also. There is no doubt that the reward of Rs. 25 was too high, but to stop it altogether was a very short-sighted policy and resulted in a great increase in the numbers of wild dogs. The spotted deer and sambur in the low country suffered severely in consequence, some parts being temporarily denuded of all game, while several packs even made their way up on to the plateau, which had been free of them for some years. In 1926 it was decided to renew the N. G. A. reward of Rs. 10 and to address Government for assistance in the matter.

So far as this area is concerned there is as yet no definite evidence of more than one type of wild dog, though a smaller and fiercer variety is said to occur just inside the Mysore boundary. This however still remains to be confirmed.

Small Game.—The game birds of the area include Snipe, Woodcock, Nilgiri Wood-pigeon, Grey Jungle-fowl, Spurfowl (red and painted), Peafowl, Sandgrouse (painted), Grey Partridge and several varieties of Quail, but compared with other districts, the shooting must be considered distinctly poor. A bag of a dozen head, on the plateau at any rate, is as much as one gun can expect in a day, and he will have to shoot straight to get even that.

Sisi and Chikor were imported and turned down some years ago, but no trace of them can now be found. An experiment is shortly being made with Burmese Silver Pheasants, and it is to be hoped that this will meet with more success. Grey Jungle-fowl have been brought up on to the plateau from the low country from time to time, certain sholas where they are released being closed to all beating, but the majority probably soon find their way down again.

In 1926 the Nilgiri Game Association decided to reintroduce rewards for the destruction of vermin, the scale being:

Wild Cats and Red Mongooses, Re. 1 each.

Hawks, Crow-pheasants, Harriers and Eagle-owls, As. 8 each.

The shooting of Jungle-hens is not permitted after January 1 each year, and shooting would improve if they were protected altogether for several years, at any rate on the upper plateau round Ootacamund.

Poaching is inevitable and all that can be done is to mitigate the evil as far as possible. The N.G.A. has for many years and at considerable expense maintained a staff of seventeen game watchers, but as they were found to be quite useless, they were abolished in 1926, and their duties taken over by ordinary Forest Guards, a special sum being set aside by the N. G. A. for rewards for reporting cases. The N. G. A. is much hampered by the amount of private Patta land in the area, over which it has no control, and on which shooting takes place without restriction throughout the year. Since the revision of the Indian Arms Act a few years ago the number of licensed weapons has increased enormously, and there is, unfortunately no doubt that poaching into Reserved Forests is far more comon than it used to be. What is needed is an Act to protect the females of deer at all times, and game birds during the nesting-season equally on private as on public land.

The Forest Rangers and their assistants in this district now receive free shooting licences, and if they will fully realize their responsibilities in the matter of Game Preservation, much might be effected.

Certain areas on the plateau are closed to shooting either big or small game, and others to beating, and it is proposed to close next year to all shooting a considerable area in the centre of the plateau to acclimatize imported Jungle-fowl and Burmese Pheasants. For many years the large tract on the west of the plateau known as the Kundahs has been closed to all beating and small game shooting. It was re-opened this season, but there is no appreciable increase in the number or size of heads in the case of Sambur, nor in the number of small game. The Kundahs are uninhabited and seldom visited except by an occasional sportsman or by men grazing herds of cattle. Its southern edge is no doubt poached to a certain extent by the jungle Kurrumbas from the Bhavani Valley, but they do not penetrate far above the cliffs. The poor results obtained seem to show that a long period of protection in the same area is a mistake, and that closed areas should not be kept as such for more than a few years.

General.—The present condition of game in the area is satisfactory, but the greatly increased number of licensed and unlicensed weapons in the hands of Patta-land shooters renders necessary stricter supervision than formerly, and an Act to regulate the sale of big game throughout the year, with severe penalties for the use of a gun except by a licence-holder in person. Unless some such steps on the lines indicated are taken at an early date, the head of game in the area will diminish rapidly, and no longer afford alike to the resident and to the visitor the sport that it does at present.

LOVEDALE, NILGIRIS,
March 3, 1927.

SOME FURTHER NOTES ON THE SECOND EDITION OF THE FAUNA OF BRITISH INDIA—BIRDS, VOL. III

BY

CLAUD B. TICEHURST, M.A., M.R.C.S., M.B.O.U., F.R.G.S.

p. 2. *Irena puella.* Even at the present day the British Museum lacks sufficient material among many of the commonest Indian species to elucidate their moults and plumages, the old idea however that any species acquires its plumage by pigmentation without a moult has been discarded by practically every ornithologist in the world; there has never been any proof that such a phenomenon can take place and a good deal of proof that such a thing is a physiological impossibility. An examination of the British Museum series however does show that first winter males resemble the adult female and by complete moult become adult the following spring. The juvenile of this well-known species appears to be unknown!

p. 6. *Oriolus o. oriolus.* I do not think there is any proof that this oriole winters in N.W. India at all, indeed the only record I can find is one from Karachi in September where it may be straggler at the seasonal migrations.

Many Indian orioles have longer wings than 142 mm. and I find a sexed series show ♂ 138-149, ♀ 132-146.

p. 24. *Saroglossa.* I cannot agree that an original error in spelling should be perpetuated, moreover it is not in accord with the International Rules to do so (Rule 19). The word is of course derived from the Greek *psar* (= a starling) cf. Psarisoma, etc. and Hodgson must have made a slip or else a printer's error crept in and it is on a par with Sturnopas*ter* altered to Sturnopas*tor* (p. 61).

p. 32. *Sturnus v. humii.* The description of the 'young birds' plumage is not at all clear. Here by 'young birds' is meant the first winter plumage and by 'nestling' the juvenile plumage. In the description of the 'nestling' plumage there is no mention made of white spots on the lower plumage nor of any buff spots on the upper plumage which we are told the 'young bird' retains. As a matter of fact the first winter birds retain none of the juvenile or 'nestling' dress, there being a complete moult, and in this dress are more profusely spotted on the under-parts than any other race of Starling. The breeding distribution is given as the Himalayas east to Nepal; it is common enough in parts of Cashmere but it must be very local now-a-days in the Simla-Almora area; at least there appear to be no records of it.

p. 33. *Sturnus v. minor.* The irides of females I shot were *bright gold* and not *white*; a very striking and distinctive feature.

p. 34. *Sturnus v. poltaratzskii.* All races of Starling vary but the majority of this race have the ear coverts *purple, not green*, and is thus in contradistinction to *v. vulgaris*; a few, which I otherwise cannot differentiate, however have the ear coverts greenish.

p. 54. Fourth line from bottom 'nesting' should be 'roosting'.

p. 56. Here as in many cases throughout the Fauna the terminology of the plumages varies. Sometimes by 'young birds' juvenile plumage is meant, sometimes first winter plumage is meant; sometimes by nestling the juvenile plumage is meant, sometimes the down plumage.

A few instances at random:—

'Young bird' =juvenile.	'Young bird' = 1st winter.	'Nestling' =juvenile.
Acridotheres ginginianus.	*Sturnus humii.*	*Hirundo filifera.*
Motacilla citreola.	*Motacilla feldegg.*	*P. icteroides.*
Emberiza calandra.	*Emberiza stracheyi.*	*Emberiza arcuata.*
Alæmon alaudipes.	*Anthus cervinus.*	*Passer montanus.*

'Nestling' = down plumage.

Motacilla cinerea.

The plumages of birds are difficult enough to understand but if the age-names of the plumages are not definitely fixed chaos is inevitable. 'Young bird' is a thoroughly bad term as it means any bird which is not adult, 'nestling' too is a loose term and both have long been given up by most writers in favour of juvenile plumage and down plumage which are fixed plumages in the life cycle.

p. 66. Sub-family *Ploceinæ*. This is said to contain four Indian species; it should be six.

p. 77. *Estrildinæ*. It is not quite correct to say that these have no spring moult. Many perhaps do not but it is a question I have not been able to go into; *Amandava amandava* however certainly has a spring (prenuptial) moult as I pointed out some years ago (Ibis 1922, p. 647).

p. 78. *Munia malacca*. On line 1 the type locality is fixed as Belgaum; lower down it is fixed as Ceylon. Looseness in fixing type localities leads to endless trouble.

p. 88. *Uroloncha rufiventris*. Here is one more example of the infinality of nomenclature; Mr. Baker renames the *Munia pectoralis* of Blyth as he considers this name is preoccupied by *Amadina pectoralis* of Gould; this is quite correct if these two birds belong to the same genus, however Mr. Matthew's in his *Birds of Australia* puts Gould's bird in the genus *Heteromunia* and if his views are adopted, Blyth's name will stand as *Uroloncha pectoralis*.

p. 91. *Uroloncha punctulata*. This bird certainly occurs in the hill Punjab, Dharmsala, Kangra Valley, etc.

p. 96. *Amandava amandava*. It still seems to be unknown though I recorded the fact (Ibis., 1922, pp. 646–7) that this Munia has a non-breeding dress which somewhat resembles that of the female and into which it moults after breeding.

p. 101. *Perissospiza*. This genus is split off from *Mycerobas* on what appear to me to be very trivial characters, especially as these Grossbeaks do not form an unwieldy group which for convenience might be divided up. The differences between say *icteroides* and *melanoxanthus* seem to be no greater than between say *Corvus splendens* and *Corvus tibetanus*.

p. 104. *P. carneipes*. The bird which ranges from Baluchistan to N. W. Himalayas and Turkestan is I consider quite separable and should stand as *speculigera* (*B.N.H.S.*, xxxi. 4).

p. 117. *Hæmatospiza sipahi*. I cannot confirm that the female has a much shorter tail than the male as stated. I measure them as follows, ♂ 67–75, ♀ 66·5–71, a tail of 55 mm. is surely not fully grown?

p. 122. *Propasser*. Here again it seems doubtful if this genus can be kept distinct from *Carpodacus* though it might be more convenient to do so. *P. rhodochlamys grandis* has the supercilium of a *Propasser* and the wing proportion of a *Carpodacus*; again in *Carpodacus macgregori* and *trifasciatus* the proportion between the tarsal length and wing-tip length is equal, thus bridging the distinction.

p. 124. *P. thura blythi*. If *Propasser* and *Carpodacus* are both recognized then *blythi* cannot be used for this bird as it is antedated by *Propasser frontalis* of Blyth which is *not* set aside by *Fringilla frontalis* of Say = *Carpodacus frontalis*. If the two genera are merged into one *then blythi is* the correct name.

p. 129. *P. rodochrous* and *rodopeplus*. Surely these names must be spelt '*rh*'? as all names should be which are derived from the Greek *rhodos*, a rose. Even if Vigors misspelt them originally a correction is provided for in Rule 19 of the International Rules—' errors of transcription, orthography, etc.'

p. 134. *Carpodacus*. If '*Carpodacus* is now often incorporated with *Propasser*' it is quite wrong to do so as *Carpodacus* is much the older genus. However perhaps exactly the opposite is intended.

p. 137. *Carpodacus erythrinus roseatus*. This name should date from Blyth (ex Tickell) *J.A.S.B.*, 1842, p. 461. Calcutta.

pp. 134–7. *Carpodacus erythrinus*. There is considerable difficulty in recognizing three races of this bird. We have in Northern Asia and Russia a bird in which in the male shows less red on the back and underparts and a female and immature with less streaks on flanks and abdomen than the Himalayan bird. These two races are perfectly recognizable and most individuals can be picked out. Over the huge intermediate area Asia Minor, Caucasus, Turkestan we find an intermediate bird which in many specimens exhibits more red than the northern birds but less than in the Himalayan; these have been named *kubanensis*. It is a very poor race as so many cannot be placed; thus I have examined spring birds from Kashmir, Ladak, Asia Minor, Tianshan, Tishkan, Kandahar, Gilgit, Pamir, N.W.F.P. and Samarkhand which can easily be matched with birds from Himalaya; on the other hand others from Tianshan, Dharkend, Ladak, Gilgit and even Sikkim are intermediate and quite like Caucasus birds. In winter it is hopeless to try and differentiate this third race as the pink colour is so overlaid that it is not possible to say that any particular birds are less rosy than Himalayan ones or not.

p. 138. *Carpodacus rubicilla rubicilloides.* This bird is *not* a race of *rubicilla*—as Prof. Sushkin pointed out some time ago—but should stand as a species (with two recently described sub-species *lucifer* and *lapersonnei*) while *severtzovi is* a race *rubicilla.* The *rubicilloides* group are more heavily streaked on the upper parts and have a relatively longer 5th primary; the *rubicilla* group have the upper parts but faintly streaked and a relatively shorter 5th primary.

Mr. Whistler's notes (*B.N.H.S.J.*, xxx, pp. 186-7) certainly do not, so far as his own records go, apply to *rubicilloides*, as suggested, but quite correctly to *severtzovi* as stated by him and borne out by his specimens. The records he quotes could doubtless in many cases be verified or not by reference to specimens in the British Museum.

p. 140. *Erythrospiza.* This, as pointed out years ago by Salvadori in *Second Yarkhand Mission Aves*, p. 36 and others, and again more recently, is a synonym of *Carpodacus*; *Buchanetes* is the correct generic name.

p. 142. *Erythrospiza mongolica.* Baluchistan is included in the breeding range of this bird. It may breed there though I know of no proof; it occurs there in winter and up till April. Of its wintering in Sind I have no record, nor has Mr. Whistler for the Punjab; nor are there any specimens in the British Museum from anywhere in the plains of India.

p. 145. *Rhodopechys sanguinea.* Does this finch really occur in Baluchistan? I know of no instance of it. As there seems to be but one record of it—Khagan Valley—within our limits and that a 'sight record' perhaps Hazara was intended instead of Baluchistan. One 'sight record' seems extremely slender evidence for including any species in a work like the Fauna.

p. 150. *Carduelis c. major.* I cannot trace this doubtful record from Ziarat but Col. Meinertzhagen certainly obtained a specimen and saw another with it at Quetta on February 27. (Ibis., 1920, p. 138).

p. 152. *Carduelis caniceps subuluta.* I have elsewhere (*B.N.H.S.J.*, xxxi, p. 4) gone in to the question of races of the Himalayan Goldfinch; my conclusions were that *subulata* (= *orientalis*) seems distinct, large and pale, from *paropanisi*, darker and smaller, but the latter is not distinct from *subcaniceps* of Zarudny.

p. 155. *Acanthis cannabina fringillirostris.* Erroneous records are indeed hard to eliminate! This Linnet from 'Daotupper, Sind' is the one Murray said his collector got at Daulatpur in Sind and gave to Hume in whose collection it reached the British Museum. I have already shown (Ibis., 1922, p. 648) that the specimen in question came from Bushire in Persia.

p. 156. *Acanthis f. brevirostris.* This race was described from Erzeroum and it is exceedingly unlikely that it breeds in N. Ladak surrounded as it is by other races, viz. *rufostrigata*, *montanella* and *pamirensis*, nor does *brevirostris* apparently breed in Tianshan, it being confined to Armenia Caucasus and N. W. Persia. It would have been better to have omitted this race especially as the inclusion rests on reputed eggs apparently without parents—a very questionable mode of identification. Recently two other races have been described *ladacensis* from Ladak, and *baltistanicus* from Baltistan (on a single male!).

p. 166. *Gymnoris.* 'Like the true Sparrows it has an autumnal moult.' There is no point in this statement (repeated again on p. 185); that is, it would apply equally to almost *all* Passerine birds. The point is that like the true Sparrows the *juvenile* has a *complete* autumnal moult. It is only half true to say that the 'young are less downy than those of the true Finches' as the young of *Gymnoris* has *no down at all*, as obtains also in *Passer*.

p. 171. *Passer d. indicus.* I long ago pointed out that the House Sparrow of Mesopotamia and S.W. Persia, though recorded by older authors as *indicus* is really *biblicus* (*B.N.H.S.J.* 1921, p. 218).

p. 172. *Passer d. confucius.* If the House-Sparrow of Burma and S. India are the same, this name cannot be used. In 1838 Burton (*Cat. B. Mus. Fort Pitt Chatham*, p. 23) named Latham's Black-throated Finch *Pyrgita nigricollis.* Latham described a House Sparrow in fresh autumn plumage? or else faded? under this name and Burton's only specimens came from S. India. This race should be called therefore *Passer domesticus nigricollis.*

p. 174. *Passer pyrrhonotus*. There is a distinct difference in sex measurement here and the range of measurement given for wings is not wide enough. W. ♂. 67–71, ♀ 63·5–66 in a large series measured.

p. 175. *Passer hispaniolensis transcaspicus*. This bird apparently does not breed in British Baluchistan though it is said to do so in Persia north of Bampur.

p. 177. *Passer montanus montanus*. The inclusion of the typical race in the Indian Fauna rests on two specimens obtained by Whitehead in the N.W.F P. and are in the British Museum. They are decidedly paler than the typical race, month for month, and they are not so pale certainly as *fresh moulted dilutus* from Kashgar, but then one can hardly compare these with the two birds in question which were obtained in February and March. Baluchi birds seem quite the same as these birds of Whitehead's and I certainly should not at present separate them from *dilutus*.

p. 180. *Passer rutilans*. This is rather a difficult group and the arrangement here given does not seem quite satisfactory though I agree that four races are recognizable.

Passer rutilans cinnamomeus. Hartert created one difficulty in restricting 'the Himalayas' of Gould's type locality to Bhutan. Gould described the bird in 1835 at a date when no specimens of birds had been received from Bhutan and so his bird could never have come thence; moreover Gould says his bird (a male) had a wing of 2¾ inches = 70 mm. and however carelessly one may measure a Bhutan or East Himalayan male one cannot make it as small as 70 mm.; a bird of this size could only have come from the N. W. Himalayas. The measurements of males from Bhutan, Bhutan Duars, Sikkim, Native Sikkim, S. Tibet and Nepal are the same and are W. 75–81. (27 measured).

Passer rutilans debilis. From Kumaon to Kashmir the Cinnamon Sparrow is represented by a race which only constantly differs from the eastern bird in being smaller, an exception to the almost invariable rule that where there is difference in size the western birds are largest. The explanation is, I think, that the breeding quarters of the eastern bird are Southern Tibet and probably the higher parts of Sikkim and Bhutan and we know that Tibetan birds of many species tend to be larger than Himalayan. In British Sikkim it apparently does not breed (Macintosh ; Stevens ;). The paleness and more yellow on the underparts of the western bird is largely individual variation, birds quite as pale and as yellow being found in the east. Wings of males Kumaon to Kashmir 70–74 mm. (35 measured).

Passer rutilans intensior. This bird was described from W. Yunnan and 15 males thence measure 69–75 mm. The males and females are rather darker than Himalayan birds. Equally dark are the Burma birds (S. Shan, Chin and Karenni Hills. ♂ W. 71·5–72 (4 specimens). Manipur Hills, ♂ W. 68·5–71·5 (9 specimens); Shillong, ♂70–74·5 (7 specimens); Naga Hills, 70–73·5 (2 specimens); Miri Hills, 71·5 (1 specimen) all these are small and within the range of *intensior* and like the latter are darker in both sexes (more easily seen in females) than East Himalayan birds and therefore I should extend the range of *intensior* to the hills of Assam. Certainly one cannot, as Mr. Baker suggests, put the small dark Manipur birds with the much larger paler Tibetan ones.

p. 187. *Montifringilla n. alpicola*. It may of course be useful to include birds in the Indian list before they have been recorded but if this plan is adopted one can hardly see where one should draw the line. This bird seems to be included on the rather slender grounds that it was the form 'almost certainly seen by Whitehead in Chitral'—hardly satisfactory evidence for an authoritative work.

pp. 197–8. *Emberiza s. pallidior*. Wintering . . . to *North-east* India, surely North-west is meant? It extends in winter far beyond the N.W. Province Frontiers to the riverain of the Punjab and Sind.

p. 200. *Emberiza f. arcuata*. In this Bunting and in *E. pusilla* the tail feathers are narrower and more pointed at the tips than in most others, a character I do not recall having been noticed before.

p. 201. *Emberiza pusilla*. Here and in many other cases throughout the Fauna the adult plumage in summer, habits in summer, nidification are described at some length while little is said about the winter habits and plumage. It may be a matter of opinion, but it would seem to be more useful to give prominence to the *Indian* aspect of birds which are purely winter visitors.

p. 207. *Emberiza c. godlewskii.* It seems more reasonable to consider *cia* and *godlewskii* as two species and not races of one since both are represented by separate races in Tian Shan ; nor is there any intergrading. The type locality of *godlewskii* is Kultuk in South Baikal. In view of the numerous races of *godlewskii* which have been described a re-examination of Indian material is desirable. The Tibetan bird has been described as *khamensis*, Sushkin.

p. 208. *Emberiza huttoni.* I must entirely disagree with the use of this name for this Bunting. Blyth described it as *Emberiza buchanani* from Buchanan Hamilton's drawings and the description is unmistakable (*J.A.S.B.*, xiii, p. 957, 1844). He says ' probably = *Emberiza hortulana apud Sykes* '. He described the bird again (xviii, p. 811, 1849) as *E. huttoni* apparently thinking he had made a mistake before, for in a footnote he says ' *E. buchanani nobis* = *E. hortulana* L '. In Blyth's own copy of the *J.A.S.B.* Blyth wrote against this footnote ' No ' showing that he realized later that he was correct in the first instance and that his *buchanani* was *not* the Ortolan of Linneus, as indeed it could not be by the description. Moreover no author can go back on his own names if the descriptions hold good.

p. 214. *Emberiza melanocephala.* This bird does not breed in British Baluchistan so far as is known ; perhaps parts of Persia are included and meant here.

p. 215. *Emberiza icterica.* The distribution of this bird needs amending, the summer and winter ranges are not differentiated at all. Mesopotamia is included in the range whence there is but one record.

p. 219. *Emberiza calandra.* This bird has not only been *recorded* from Jhang in the Punjab but both Mr. Whistler and myself *obtained* it there ; his specimen is in his collection and mine I presented to our Society's Museum. I mention this because our records seem to be put on a par with Murray's Sind bird which as I pointed out before (Ibis., 1922, p. 656) did not come from Sind at all but from Bushire in Persia, and one would think the ' record ' need not have been resuscitated in a work like the Fauna.

pp. 219-220. *Emberiza citrinella erythrogenys.* Over a page is devoted to this species, yet its distribution in India has been entirely omitted ! Has it ever occurred in India at all ? I know of no record.

p. 226. *Delichon urbica urbica.* A good series of breeding birds from India are most desirable ; all that I have seen are shorter winged birds than most of the typical race and I feel doubtful if the Indian birds belongs to the typical race. Surely it is not a common winter visitor to N. W. India ! ? Mr. Whistler obtained two specimens in 16 years in the Punjab and *only saw it occasionally on passage* to and from the hills.

p. 228. *Delichon u. cashmeriensis.* This is most certainly to my mind *not* a race of *urbica* but a separate species. Not only do both breed close together in Ladak but they do not intergrade anywhere. Moreover the tail is much more deeply forked in *urbica* and the proportions of tail to wing are quite different in the two ; viz. :—1 to 2 in *cashmeriensis*, 1 to 1·6 in *urbica* ; on such differences other species have been put into different genera !

p. 233. *Riparia riparia subsoccata.* When I described this bird as *R. r. indica* I went pretty thoroughly into any possible names already available. It is true that Jerdon's *subsoccata* refers to this Sand Martin but Jerdon who did not know the bird quotes what Adams said about it. The latter described the bird well and was the first to do so (*P. Z. S.*, 1859, p. 176) under the title *Cotile subsoccata* Hodgson ? Unfortunately however Horsfield and Moore in their Catalogue (i, p. 96) in 1854 had already used up Hodgson's *nomen nudum* by quoting it as a synonym of *sinensis*, therefore *subsoccata* cannot be used for any other species.

p 234. *Riparia r. ijimæ.* Under nidification this species is referred to by some curious slip as ' these little *Swifts* '!

p. 239. *Ptyonoprogne obsoleta obsoleta.* I too in the ' Birds of Sind' made the mistake of uniting the Indian and Egyptian bird and this I have (*B.N.H. S.J.*, xxxi, p. 4) since rectified. At the time I was working at them there was not sufficient material from Egypt available to me in the same state of plumage as the Sind birds. Since then however I have obtained a comparable series from Egypt, and Sind winter birds are distinctly *darker* than winter Egyptian ones ; unfortunately however they must bear the name *pallida* of Hume.

p. 240. *Hirundo rustica rustica.* I cannot verify these wing measurements at all; surely no full winged adult has a wing so small as 110 mm.? I measure a fair series of adults, ♂ 124·5–132, ♀ 120–126. (W. Europe).

As regards the distribution of *rustica* and *gutturalis*, I shall confine my remarks to N. W. Indian birds. In the first place *gutturalis* is an eastern bird described from a winter bird in the Philippines and the breeding range of it is extensive over N. E. Asia. Now a series of adults from winter quarters—Philippines, Java, Sumatra, Malay (which may be taken as a topo-typical series and are the same as the N. E. Asiatic birds) present the following characters compared with W. European *rustica*.

1. Wing smaller, ♂♀ 109–120, mostly under 118 (25 measured).
2. Under parts variable; some whitish, some pinkish.
3. Red of throat and forehead deeper on the average.
4. Pectoral band variable; broken in some, in others smudged (i.e.) tips of some of the feathers in centre of band chestnut but band not broken. Now taking these characters separately; wing length is a good character there being but a small number which overlap; underparts—no guide at all; all over the range of *rustica* one may find birds with white or with pinkish underparts and every intermediate; deepness of chestnut red colour is an *average* distinction only; the pectoral band in *rustica* is never, I think, completely broken but 'smudged' bands are *often* seen so that this character is good only when the band is broken.

Now breeding birds from Cashmere, Gilgit, Yarkhand and winter birds from Sind, Punjab and Beluchistan are all large birds, wing ♂ ♀118, 119, 120–129 (25 measured); most have the band unbroken and some have it smudged but in none is it completely interrupted. I therefore consider all to be *rustica* and *gutturalis* not to occur in N. W. India at all.

p. 242. *Hirundo rustica tytleri.* The type locality was fixed by Jerdon as Dacca; if Oberholser also fixed it as Dacca it was a fortunate though needless act!

p. 245. *Hirundo smithi filifera.* This I think is a recognizable race though Mr. Baker hardly thinks so; the wing measurements may overlap but in measurement of the tail wires, I found only one overlap in 28.

Surely in this case the 'nestlings' and 'young birds' described are one and the same states of plumage? that is to say, the juvenile plumage in which it leaves the nest and which it retains till it moults to adult dress, as with other Swallows.

p. 248. *Hirundo daurica daurica.* This bird seems scarce in collections; in the British Museum and Tring Museum I find 21 specimens some of which are not sexed; the wing measurements are ♂ 127–133, ♀ 122–128–131. The statement that this race breeds in Shillong is not borne out by any specimens. I have seen four specimens taken within Indian limits:—♀ Sadiya, June 3; ♀ Sadiya, June 8 (type of Hume's *intermedia*; one Cachar, no date, in moult and so obviously not breeding; ♀ Cachar May (this bird seems to have a smaller bill than typical *daurica*); as we are told that it does not arrive in Shillong till late in July all the above birds in May and June may have been on passage for further north. That it should breed in Shillong would be very remarkable as the nearest breeding quarters are many hundreds of miles to the north, moreover in Shillong another race (*striolata*) certainly breeds. A few breeding specimens would be desirable.

p. 249. *Hirundo daurica striolata.* A series from the Southern Shan States, apparently breeding, are all large birds, W. 127–136, but there do occur small birds which seem to only differ in being small; thus a male from Cachar. W, 126 is 'type 2' of Hume's *substriolata* and another ♂ Manipur, W. 120, is exactly like it but may be this has been sexed wrongly. Here again there seems to be great lack of breeding and of sexed specimens. It would appear to breed in Central Formosa (specimens May and June) and perhaps Luzon and Lombok? (specimens July). The juvenile is distinctly heavier streaked below than the juvenile of *nepalensis*.

p. 250. *Hirundo daurica nepalensis.* This is perhaps the most difficult of a puzzling group and I have examined and measured every adult bird in the British and Tring Museums besides all in Mr. Whistler's collection, 102 specimens in all.

Adult. 1. Himalayas, east to Nepal; 25 specimens, ♂ wing 111–117, odd ones 119 and 120, ♀ 110–116.

2. Assam, Burma, Yunnan, 30 specimens, ♂♀ 116–125. Yunnan (Talit) May 21 and Mekong-Yangzte Divide June 5 are the only two which are possibly breeding birds.

3. China. 9 specimens, May to August, ♂♀ 112–124·5 from Shanghai, Chihli, Shantung, Kuangtung Provinces.

18 specimens, September to April, ♂♀ 114–124·5 from Shanghai, Chihli, Fokien, Kwangtung, Kwangsi Provinces.

Of these 27 specimens only 4 are under 115.

4. Japan. 7 Specimens, ♂♀ 117–124.

5. Corea and Manchuria, 9 specimens, ♂♀ 117–125. April and July.

6. Afghanistan, 3 specimens, 113–116. Pushut and Byan Khel.

It will be seen from this that topotypical *nepalensis* from the Himalayas are smaller birds than those from China, Japan, etc. and *on the whole* they are less coarsely streaked. The collar on the hind neck varies much ; in the types of *nepalensis* the collar is unbroken but I do not think this is constant for Himalayan birds ; in Chinese birds it always seems to be broken. In Assam, Burma and the plains of India one finds some birds are larger than the Himalayan breeding birds but since these are winter visitors they may not have come from the Himalayas. A series of breeding birds from Manchuria are quite strikingly different to a similar series from the Himalayas and though every bird from China and Japan are not to be picked out from Himalayan birds I think that as a race they should be recognized and the name for them will be *Hirundo daurica japonica* of Tem. and Schl. As all Chinese and Japanese birds seem quite the same ; *Hirundo arctivitta*, Swinhoe described from Pekin (4 examined, only one adult) is not different to *japonica*.

The three birds from Afghanistan are *not nepalensis*, they have hardly any striæ on the underparts and seem quite like *rufula* but are smaller than this race. Further material is desirable ; if it should turn out to be a recognizable race the name *H. scullii* cannot be used for it. It was said in the description of this that it occurred in Gilgit and Nepal but the type in Seebohm's collections was obtained by Scully in ' the Residency grounds in Nepal ' (*vide* B. M. Cat.) and therefore *scullii* must be a pure synonym of *nepalensis*. In the Ibis, 1916, p. 71 I identified some birds of Mr. Whistler's from Jhelum as *scullii*, but *nepalensis* is of course the older name.

p. 252. *Hirundo daurica rufula*. I think I am correct in saying that Mr. Whistler certainly never found this race breeding in the Kangra Valley, and certainly no specimens in his collection refer to this race. The mistake arose (*B.N.H.S.J.*, xxi, p. 659) through this bird being identified as *scullii* and Mr Whistler's remarks that this ' apparently corresponds to *Fauna of B.I.* No. 824, *H. rufula*.' The bird in question is *nepalensis*.

p. 251. *Hirundo daurica erythopygia*. There is much yet to be learnt about the distribution of this race in the Himalayas. In some places it ascends to over 4,000 ft. and breeds in same area as *nepalensis* ; it requires very detailed study. The distribution in the plains of India is hardly as wide as is given, as it is practically absent over a very large part of the Punjab and Sind. In the description this race is compared with *striolata* and *daurica* but size alone will differentiate it from these two as the measurements do not overlap ; moreover it does not occur in the same area. It is from *nepalensis* that it needs to be distinguished ; chestnut colour is darker and on the rump does not pale off so much as in *nepalensis*, the exposed black of the undertail coverts is not so extensive—10 to 16 mm. as against 15–25 in *nepalensis* ; and besides having a shorter tail, as pointed out, the fork of the tail is consequently not so deep—from the tip of the centrals to the tip of the laterals in *erythropygia* is 30–37 mm, whereas in *nepalensis* it is 40–50 mm. Wing length is not so diagnostic, *erythropygia* mostly 105–113, *nepalensis* 111–117 ; I cannot find any adult *erythropygia* with a tail as short as 65, I measure ♂ 76–83 ♀ 72–78, in a long series. In the juvenile the rump is distinctly darker than in *nepalensis*, in fact in the latter when worn it is not darker than cream-coloured.

p. 256. *Motacilla alba*. The difference in wing length between *alba* and *dukhunensis* has not been stressed *alba*, ♂ 88–92·5, ♀ 84–88·5, *dukhunensis*, ♂ 91–96, ♀ 84–91. These measurements, taken from W. Europe and from Yenesay specimens, may be useful to distinguish doubtful specimens.

p. 258. *Motacilla a. persica*. Unless an adult male of this race has been found in India, it is best omitted from the Indian list as it is most unlikely to occur ; so far as we know it is quite resident in its range and that it should migrate hundreds of miles eastward would be quite a new fact which only ought to be recorded on incontravertible evidence. *Persica* is rather paler on the back than *personata* and slightly smaller, and has a longer bill than *dukhunensis*.

p. 261. *Motacilla lugubris*. Surely the correct name is *M. yarrelli* as pointed out by Newton and others years ago ? ; *lugubris* of Temminck was quite indeterminable. In any case if one follows Mr. Baker in considering *maderaspatensis* a race of this group, and not a species in itself as I do, then the latter name must be used for the group as it is many years older.

Any one who wishes to identify any but the adult males of *alboides* and *personata* will find some help in *J. B. N. H. S.*, xxviii, p. 1089 where I went rather fully into the question, and also into the reason for considering *maderaspatensis*, a species of itself.

p. 265. *Motacilla cinerea*. The tail length is given as 75 mm. ; it should be 95. This mistake is repeated on page 266 where the tail length 67–73 should be 87–93.

The down of *M. c. caspica* is dirty white.

p. 267. *Motacilla flava*. Further details of the plumages of *beema* and *thunbergi* will be found (op. cit., p. 1087) and also the distinguishing characters of the male of *Motacilla flava simillima* which has been omitted altogether in the Fauna. The only Indian example of *leucocephala* was obtained by Mr. Whistler at Jhelum ; for first occurrences it is surely of interest to give full data.

p 271. *Motacilla feldegg*. More details on the plumages of both races will be found in op cit., p. 1086. Mr. Baker says the young (= 1st winter) of *feldegg* have no trace of a supercilium if that is so they should be quite easily distinguished from first winter *melanogriseus* which has a well-marked whitish or buffish white supercilium as I pointed out (*loc. cit*).

Some few adults which occur in India may not be separable from *feldegg*, the vast majority I think are undoubtedly *melanogriseus*. The Shiraz breeding bird is quite certainly *M. f. feldegg* (series of breeding birds examined) and not *melanogriseus* as Mr. Baker states nor did Mr. Witherby ever record them as *melanogriseus*.

p. 273. *Motacilla citreola*. I went very carefully into the question of the plumages of both sexes and of all ages in *citreola* and *calcarata* (op. cit., p. 1084) and to this I must refer all who wish to distinguish them as only a very small percentage could be differentiated by the descriptions given in the Fauna. I also pointed out that *calcarata* has the longer tarsus whereas Mr. Baker gives *citreola* the longer. I do not think he is right. The combined measurement of tarsus, middle toe and claw in *citreola* is usually well under 47 mm. and in *calcarata* well over 47 mm.

Although not alluded to, it was pointed out by Prof. Shushkin (*Proc. Boston. Soc.*, August 1925) that *M c. weræ* from S. E. Russia and Turkestan is a recognizable race in that it is smaller (♂ W 77–85) and is less grey on the flanks and this is the form found in N. W. India in winter whereas the Bengal, Assam, and Burma birds belong to the typical race *citreola* from E. Siberia (♂ W 88–93) see also *Bull. B. O. C.* xlvi, p. 114.

p. 276. *Dendronanthus indicus*. Distribution. In winter south to India *east*, not west, of a line from Sutlej Valley to Gulf of Cambay.

p. 278. Genus *Anthus*. To say that ' the difference in plumage in summer and winter is negligible ' is rather an astounding statement ; one could hardly find more different looking birds than say winter and summer *blakistoni* or *japonicus* or again winter and summer *cervinus*.

p. 279. *Anthus trivialis trivialis*. The type locality should be *Sweden*, not Switzerland.

p. 281. *Anthus hodgsoni hodgsoni*. The winter distribution given is far too sweeping. There are enormous stretches of N. W. India where it is not found in winter as I pointed out in *Ibis*. 1923, p. 7.

This species is highly variable and one may see birds obtained at the same place and same time of year which look utterly different ; some have the upper parts heavily spotted others have hardly a spot ; such birds I have seen from Sikkim in August and from the plains in winter. *Berezowskii* does not seem to be a recognizable race at all ; Kansu birds in worn dress of course have lost the green of the upper parts but so have Himalayan ones. Spring birds from Kansu and China, etc., are not different to Himalayan ones ; they do not appear to me to be darker. *Yunnanensis* is only recognizable in a series in fresh autumn plumage when on the whole the upper parts are darker ; in breeding dress a series from Yunnan do not seem to be separable from a similar series from the Himalayas; a poor race.

p. 287. *Anthus sordidus decaptus.* Sind is apparently included in the breeding range of this bird; it is only known as a winter visitor there. Besides size, this race differs from *A. s. captus* in being less pale and grey above in fresh plumage.

p. 289. *Anthus richardi godlewskii.* It is quite true that *striolatus* of Blyth cannot be used for this bird as in some unaccountable way (? from Blyth's MS.) Gray quoted Blyth's name as a synonym of *rufescens* in the year before Blyth ever published his name. But by the same interpretation of the rules of nomenclature *Anthus thermophilus* of Jerdon must be used for this bird as in the *Birds of India*, p. 233. 1863, Jerdon uses Hodgson's *nomen nudum* as a synonym of *striolatus* with description. This bird must then be called *Anthus richardi thermophilus*, Jerdon, ex Hodgson. Type locality Nepal. The distribution given is too sweeping ; this bird does not occur over the greater part of N. W. India at all.

p. 291. *Anthus richardi rufulus.* I feel very doubtful if *rufulus* is a race of *richardi* ; it appears to me to be more probable that it is a species which itself has many races both in the Oriental and Ethiopian regions. The form of this bird which occurs in Ceylon is certainly *not* the same as inhabits Bengal and N. India generally ; it is a much darker bird and I cannot separate it from *malayensis* and so should extend the range of that race to Ceylon.

p. 292. *Anthus campestris campestris.* The Tawny Pipit, is a common bird in N. W. India in winter and Mr. Whistler and I have a very large series from Sind and the Punjab. Not a single specimen belongs to the typical race, yet from the distribution given one may infer that it is common. I cannot credit it and from the breeding distribution of the race one would hardly expect it to be.

The wing measurements given are misleading and must apply largely to females, as I measure a series of males as 91–98·5 mm.

p. 293. *Anthus campestris griseus.* This was described in 1920, not 1923. Here again the measurements given can only apply to females ; a large series of males measure W 89–95, T 71–76. The habits of this bird in India have been recorded by me (Ibis., 1923, p. 7).

p. 294. *Anthus cervinus.* The red head and throat is certainly acquired before the third year. I have examined specimens moulting into the red dress in the first spring and this is probably normal, whether they then get redder and more immaculate with age is speculation.

p. 296. *Anthus roseatus.* Habits. It is unfortunate that in so many cases so little space is devoted to habits. In this species the habits in the breeding season only are briefly referred to. The habits in winter have been recorded over and over again by Indian writers and are so utterly different to the breeding habits that some mention might have been made of them. But we are told only that the habits are ' those of the genus.' It is not at all clear what is meant by this statement which is repeated again under Tawny Pipit and one of the Water Pipits. No description of the habits of the genus is given under the genus *Anthus* and as several of the species have entirely different habits to refer to any one species has having the ' habits of the genus ' seems meaningless.

pp. 297–8. *Anthus spinoletta.* The two races *coutelli* and *blakistoni* are not very satisfactory at least as regards winter birds ; so many are intermediate between what may be called typical specimens of the two races and as stated we know so little about the breeding ranges of both races. Probably both have a very large range and intergradation is found. *Coutelli* certainly breeds on the Persian plateau.

The winter habits of *coutelli* have surely been recorded ? it is one of the commonest birds in the Nile delta. I have measured a large series of topotypes of these two races and could find no difference at all in measurements (cf. *B.N.H.S.J.*, xxviii, p. 229). It would have been more helpful I think to have given the winter plumage of *coutelli* as summer plumaged birds in India must be very rarely met with, moreover the description of *blakistoni* is compared with *winter coutelli*.

p. 309. *Otocoris alpestris longirostris.* Spiti, Lahul, and Kulu should be added to the distribution of the race. *Elwesi* reaches as far west as the Tso Kar, Tso Morari and Pangong Lakes in Ladak and north to Aktagh north of the Karakoram Pass that is to say to long. 78°E. The rest of Ladak, except the Deosai plain whence a recently described race comes, is inhabited so far as is known by *longirostris*. Baluchistan however would seem to be outside the range of this latter bird ; I know of no record within the boundaries.

p. 313. *Melanocorypha bimaculata*. This bird does not so far as is known breed in British Baluchistan.

p. 315. *Alauda arvensis dulcivox*. This bird does *not* breed in Baluchistan. The Skylark breeding at Quetta recorded by Marshall and others is a *gulgula*. Whitehead never recorded an *arvensis* breeding on the Afghan Frontier ; he expressly states that *arvensis* was a winter visitor there and the breeding bird is a *gulgula*, as might be expected. As he well knew the difference between the two birds he probably was not mistaken. The Persian breeding bird is *Alauda arvensis schach* which seems to be perfectly recognizable and nothing like *dulcivox*.

p. 319. *Alauda gulgula gulgula*. Wing measurements of races of Skylarks which do not give measurements for each sex are of little value as there is a considerable difference between male and female. In this case the measurements given 82–92 can surely only apply to females ? as a series of males measure 92–97 mm.

p. 321. *Alauda g. cœlivox*. *For* ' Distribution ' *read* ' Description.'

p. 324. *Calendrella brachydactyla brachydactyla*. The Short-toed Larks are admittedly difficult birds to place as they vary a good deal but it appears to me that the typical race has been dragged into the Indian list on somewhat, slender grounds though the erroneous breeding distribution given makes its inclusion look quite possible. The bird which breeds in Palestine is *hermoniensis* as also are the few Persian birds I have seen. No form of *brachydactyla* breeds in British Baluchistan so far as we know. Where then do the supposed examples of the typical race found in winter in India come from ? I can hardly credit that they migrate from South Europe. I think the truth is that we have in this group a species which varies slightly in colour according to the ground it inhabits in the breeding season and that though the prevailing tone of colour of the central Asiatic birds (*longipennis*) is paler and greyer, yet over this area there will be found some which are browner and redder and resemble the European bird and these are the ones which pass as the typical race in India. If we are to maintain these three races at all I think this is the most reasonable explanation and not to imply that European birds migrate to India in winter. These browner Asiatic birds were apparently given a name *C b. orientalis* in 1925 by Sushkin.

p. 326. *Calandrella b. dukhunensis*. This race largely replaces *longipennis* in Central and Eastern India. The more rufous upper parts and the tawny tinge on the pectoral band and flanks coupled with a slightly longer wing and bill differentiate the vast majority. In the British Museum there is a fair series of these but some so labelled do not, I consider, belong to this race. The wing measurement ranges from 95 in small females to 104 in males ; I find none so small as 90 mm. as stated. There are no specimens *west* of Etawah and Mhow nor are there any specimens from Karachi. Sind and the Punjab lie outside the range of this bird.

p. 327. *Calandrella acutirostris acutirostris*. The breeding range must certainly be extended to British Baluchistan and probably to Afghanistan. I cannot separate a sufficient number of *tibetanus* to justify its recognition ; the amount of white in the tail varies very much and so does the colour of the upper parts.

p. 329. *Alaudula*. It is of course a matter of opinion whether such characters as shortness of inner secondaries and slenderness of bill constitute grounds for generic separation. However in this case slenderness of bill surely does not hold good as *persica* has a stouter bill than some *Calandrella*.

p. 331. *Alaudula raytal adamsi*. The wing measurements of this bird reach as correctly stated 88 mm., but as this is so it upsets the key to the species on page 329 where birds with wings over 85 are referred to *rufescens*.

p. 332. *Alaudula rufescens persica*. The wing measurements given are too small, none out of a large series I have measured is so small as 86 ; 94 I found to be the minimum. It is not clear what the locality of the supposed eggs taken by Barnes is. Peshawar is not in Afghanistan ; perhaps in Afghanistan near Peshawar is meant or possibly Peshawaren on the Helmund ? but if Barnes did not get the breeding birds surely no value can be attached to this record ? It is however not correct to say there is nothing on record about the breeding of *persica* as it has been fairly well described by Blanford (*Eastern Persia*, ii, p. 243) under the name of *Calandrella pispoletta* ; Blanford's breeding birds obtained and so recorded were *persica* (examined by me). This race has occurred at Sirsa in Punjab in winter but not I think in Sind—at least I have been unable to find any examples thence in the British Museum.

p. 333. *Alaudula rufescens seebohmi.* In addition this race has occurred at Sirsa in Punjab (Hume coll.) and in N. Baluchistan (Meinertzhagen).

p. 333. *Mirafra.* The wing has surely 10 primaries ; by a slip it is said to have two !

p. 344. *Galerida cristata chendoola.* I should certainly expect the breeding birds at 7,000 feet in the N.W.F.P. to be *magna* and not *chendoola* as also obtains in N. Baluchistan and I have no recollection of ever saying nor I can find that I have ever recorded the exact opposite, as Mr. Baker avers. Mr. Baker is not correct in saying that this species never perches on bushes or elevated positions. I have seen it sitting on the top of tall euphorbias and on telegraph wires on innumerable occasions as I recorded, Ibis. 1923, p. 18 and *B.N.H.S.J.*, xxviii, p. 226, for *magna*.

p. 349. *Ammomanes.* There is a muddle over the proportions of the primaries in the introduction to the genus. Obviously the first primary cannot be one-third the length of the second and the latter 6 mm. *shorter than the first !*

p. 350. *Ammomanes phœnicura phœnicura.* Distribution given should be *east* of a line drawn from Rann of Cutch to Delhi, *not west* of it.

p. 351. *Ammomanes phœnicura zarudnyi.* This bird has also occurred in Sind, a fact I was not aware of when I wrote the *Birds of Sind.* I have however since found a bird in Tring Museum obtained by Blanford on December 21, 1875, near Sehwan ; he had passed it over as an immature of *phœnicuroides.* Status in Sind not known ; elevational migrant from Kelat ? or possibly resident ?

pp. 353–4. *Pyrrhulauda grisea.* The bird inhabiting the dry plains of N. W. India is easily separable from the South Indian bird. I described it as *P. g. siccata* (*Bull. B. O. C.* ccxcv, March 1925). Mr. Baker has omitted all reference to this though the Bulletins of May and October 1925 are quoted for other species.

p. 358. *Zosterops.* The grouping of this difficult genus did not seem very satisfactory nor in accord with my experience and I have recently gone into this group and some of the results are given in the *Bull. B. O. C.* xlvii, February 1927. For those who have not seen this I will repeat the main points and add a few others.

Zosterops palpebrosa. There is no doubt that Temminck described the Bengal bird, and probably from near Calcutta, and this is the darker, greener type as opposed to the paler, more yellowish bird found over N. W. India, etc. This latter Mr. Baker has recognized but unfortunately he described the yellower bird (*elwesi*) as being smaller and placed the type locality of it as Sikkim. However there is not the slightest doubt that the Sikkim and Bengal birds are the same and therefore *elwesi* is synonym of *palpebrosa*, they are of the same colour and have the same measurements :—

Bengal, W. 49–55, B 11·5–13.
Sikkim, W. 49–54, B 11·5–13.

So that the yellower bird which also is *larger*, not smaller, still lacked a name and for it I proposed the name *Zosterops palpebrosa occidentis* (*Bull. B. O. C.* xlvii, p. 88). This bird ranges through the Himalayas from the vale of Nepal westward to Kashmir, N.W.F.P., Punjab, Sind (Karachi), W. United Province, Central Province, east to Raipur, Rajputana and Bombay Presidency south to N. Kanara and Mysore. W. 53–59, B 11·5–13.

Mr. Baker has separated the Assam bird as *cacharensis* and says it is smaller than the typical race and shews a yellow streak down the abdomen. I have examined Mr. Baker's type and a series of topotypes and in all 62 specimens from Assam and I find the abdominal streak or a trace of it in only 22 specimens. This seems hardly constant enough to constitute a recognizable race and moreover it is found in specimens outside Assam, thus quite a number from Sikkim show it also some from Yunnan and from the Nilgiris. The wings of Assam birds measure 49–54·5, quite the same as in *palpebrosa*, and therefore I consider *cacharensis* to be also a synonym *palpebrosa*. The range of the typical form will then be Bengal and Sikkim east to Assam, Kauri, Kachin, N. and N. W. Yunnan, S. Shan States and Karenni. The distribution south of Bengal still needs working out and there are no specimens for examination from N. Circars and Orissa, Hyderabad State and Madras.

The bird which inhabits the Nilgiri and Palni hills is I consider separable; it is of the same coloration as *palpebrosa* but it is larger in wing and bill I have named this (*loc cit.*) *Zosterops palpebrosa nilgiriensis*, W. 54·5–58, Bill, 13-14; doubtfully separable from this is the Andaman bird but the Nicobar bird *nicobariensis* has also a large stout bill but is smaller in wing, 50–53·5. The Ceylon and Laccadive bird *egregia* is peculiar in being even brighter and yellower above than *occidentis*, as most Ceylon races run to darkness in colour.

In coming to these conclusions I have examined and measured over 300 specimens.

Zosterops simplex. This is the Chinese bird and Mr. Baker recognizes a race of it within our limits—*peguensis*. The series available in the British Museum do not seem to be different to birds from China either in colour or size. There is no doubt that although *simplex* is rather like *palpebrosa* it must at present be considered a species and not a race. Both *appear* to breed over a considerable area in W. Yunnan. The same remarks apply to *aureiventer* which within our limits appears to overlap the ranges of *palpebrosa* and *simplex* in Burma. But there is yet a lot of careful field work and collecting to be done in the areas where two species occur to ascertain their distribution, whether there is any altitudinal difference in habit and whether there is any interbreeding and intergrading.

p. 378. *Æthopyga siparaja seheriæ.* The geographical range of *seheriæ* and *mussooriensis* seems to be entirely a question of east and west, all males from Sikkim and Native Sikkim have short wings (54 5-58 mm) as have also males from Bhutan, Assam, etc., whereas the western birds are larger (61–62·5 mm.). The difference is small but the variation in wing length of all Sun birds seems to be very little. Nepal birds (*miles*) stand out rather prominently with dull grey underparts with no olive green or only a trace (wing 55–61) and I think this race should be maintained. It seems hardly credible that Hodgson's method of preparing his skins should account, as suggested, for the grey underparts. *Andersoni* with violet crown and tail, instead of green, is, I think, no doubt, a sporadic variety (4 examined from N. Bhamo, Minjin and L. Chindwin). Quite typical *seheriæ* also occurs in Bhamo and Upper Burma (which is omitted in the distribution of *seheriæ*). Violet and green metallic reflections vary in many sunbirds, sometimes geographically and sometimes not, but the wetting of the plumage as suggested by Mr. Baker as the cause in this case has, I am sure, nothing to do with it as I have experimentally proved. The crown of *seheriæ* when wet goes dull but on drying out the original green reflections are restored.

The juvenile of this and of *mussooriensis* is *not* like the female; juvenile male has the throat and chin brick pink, the juvenile female has not but is greyer, not so yellow on the underparts; *otherwise* they are much as in the adult female. Full plumage is assumed by complete moult and this is then held all the year as also in *vigorsi*, the moult taking place in this species (or race?) from March to May in both sexes.

I think Mr. Baker is quite right in rejecting the name *goalpariensis*; the type specimen is certainly labelled as from Dehra Dun, but it is a quite typical *seheriæ* with wing 55 and certainly never came from this locality, as all other specimens thence are quite typical *mussooriensis*. But surely this last race does not reach the Afghan frontier? Dharmsala is the furthest west I can trace it.

p. 383. *Æthopyga ignicauda ignicauda.* Males, wing 58–61. There is not the slightest doubt that this species like *Cinnyris asiatica brevirostris* has a dull winter dress. It is green like the female but the underparts are brighter yellow and often show some odd orange feathers. Tail longer than in the female, outer webs red, centrals not prolonged more than half an inch beyond the rest, otherwise tail as in summer; tail coverts scarlet, rump yellow. Many specimens in this dress in the British Museum are labelled females but by measurements alone they are sexed wrongly. Moult out of this dress starts in February and lasts till April the body plumage, central tail or whole tail, but apparently not the wings, are moulted to the full dress. After breeding the males moult again and assume the above dull dress (specimens in old full dress with the new green feathers 'in pin' examined).

p. 384. *Æthopyga flavescens.* A specimen from the Naga Hills seems to be of this race.

p. 386. *Æthopyga gouldiæ gouldiæ.* Juvenile. Like the female but tail not so graduated, nor tips so white. Complete moult September to December to full dress which is then retained all the year.

p. 387. *Æthopyga dabryi* or as I should call it *Æthopyga gouldiæ dabryi.* Juvenile. Only one seen (unsexed) is like female but tail not so graduated and tips not so whitish ; complete moult January to April (or earlier ?) to full dress which is retained the whole year.

p 388. *Æthopyga saturata.* Juvenile (unsexed) is like female but tail not so graduated and tips not so white. Complete moult to full dress which is then retained all the year. Surely *sanguinipecta* is a race of this ?

p. 391. *Æthopyga nipalensis.* Juvenile (unsexed) is like the female but tail not so graduated and tips not so white ; one, perhaps a male, has an orange wash on the breast which another labelled female lacks. Complete moult to full dress which is then retained all the year.

p. 393. *Leptocoma.* The Sunbirds can be split into almost as many genera as there are species according to the varied ideas of generic distinctions. The type of the genus *Cinnyris* is *C. spendida* (by subsequent designation of Gray) and this bird does not seem to be sufficiently generically distinct from such Sunbirds as *lotenia*, *asiatica* and *osea.* Now *osea* and *asiatica* are so close that the one might almost be considered nothing but a race of the other yet we have an Indian faunist putting *asiatica* in a genus *Leptocoma* and an Ethiopian faunist putting *osea* in the genus *Cinnyris !*

p. 394. *Leptocoma lotenia.* Unlike *asiatica brevirostris*, adults seem to have the metallic dress all the year, moulting September to November. The juvenile has a complete moult in April and May to the adult dress. Is Mr. Wait correct in suggesting that the adult has a distinct winter dress ? (*Birds of Ceylon*, p. 164). I have certainly examined two birds September and November moulting from metallic to metallic dress.

p. 401. *Leptocoma ornata.* There is something wrong with the reference to Lesson. The date I think should be 1826.

p. 421. *Dicæum.* A neuter genus always accentuates the difficulty as to how the specific name should terminate. The International Rules help up to a point as Rule 14 states that the specific name should agree, if an adjective, with generic and Rule 19 states that the author's spelling should be adhered to unless there is an error of orthography, transcription, etc. But the difficulty is to know whether an author intended his name to be an adjective or a substantive and whether therefore there has been an error in orthography or not ; and the difficulty always arises in cases of compounded words. It should be clear I think that where two substantives have been compounded into a specific name this should be kept as a substantive unless the original author clearly has treated it as an adjective ; thus *ignipectus* should not be altered to *ignipectum* (p. 427). So also Eyton clearly intended *ignicapilla* to be a substantive and this should not be changed to *ignicapillus* (p. 437). Words compounded of an adjective and substantive are not so clear and I think one should follow the original author's spelling ; for instance Hume wrote *Zosterops aureiventer ;* did Hume make a grammatical error or did he intend his word to be a substantive ? He must have been perfectly well aware that *zosterops* is a feminine noun. Words derived from the Greek and ending in *os* are another difficulty. Latham and Linnæus spelt their specific names, if proper names and therefore substantives, with a capital but they clearly also intended words ending in *os* to be substantives also ; thus Latham in his genus *Certhia* makes all adjectival specific names agree in the feminine but he writes *Certhia erythorhynchos* and this should not be changed to *erythrorhynchum* when associated with *Dicæum* (p. 432) though such adjectives as *ceylonensis* (p. 433) and *siamensis* (p. 424) ought certainly to be altered to *ceylonense* and *siamense.* These are trivial points of no real importance but one still hopes for the uniformity in these matters which appears as unattainable as ever.

Corrigendum to vol. ii. *Phylloscopus t. sindianus.* I have since seen good series of breeding birds from Ladak and I think that there is no doubt that this race breeds there. I am not sure that still yet another race does not occur in the plains in winter ; three other races have been described by Russian ornithologists which if recognizable might occur in winter in India.

TWO NEW SPECIES OF GRASSES FROM PANCHGANI

(SATARA DISTRICT)

(*With two plates*)

BY

E. BLATTER AND C. MCCANN

Dichanthium panchganiense, Blatter and McCann, *spec. nov.* (*Andropogoneæ—Amphilophiastræ*). A *Dicanthio armato* Blatter and McCann (=*Andropogon armatus*, Hook f.) differt praesentia ligulae laceratae, gluma involucri inferiore spiculae sessilis, gluma involucri superiore spiculae pedicellatae semper foveolata.

Foveola supra indicata hanc speciem a *Dichanthio McCanni* infra descripto distinguit.

Annual, erect; stems up to 35 cm. long, slender, tufted or not, simple or branched from near the roots, smooth and shining; nodes bearded. Leaves up to 8 cm. by 4 mm., linear, acuminate, broadest in the middle, short-ciliate, on the margins, with long, bulbous-based hairs on the surfaces, which are much longer at base of the blade for about 5 mm.; sheath lax, margins and upper two-thirds covered with bulbous-based hairs, mouth with much longer bulbous-based hairs; ligule narrow, membranous, lacerate. Racemes digitate, 1-3, about 3 cm. long. One or two of lowest pairs of spikelets male. Peduncles up to 8 mm. long, capillary; joints and pedicels slender, not grooved, terete, hairy. Spikelets about 18 pairs. Sessile spikelets 3 mm. long; callus very short, bearded with silky hairs; lower involucral glume thin, broadly oblong, substruncate at apex, margins incurved, 7-nerved, always with a deep dorsal pit about ⅓ from the apex, hirsute throughout except on the pit and the area between the pit and apex, upper involucral glume, oblong-lanceolate, longer than the lower, subacute at apex, keeled, glabrous except on the hairy keel. Lower floral glume oblong, flat, hyaline, nerveless, acute or obtuse at apex, a few scattered hairs on the margins; upper represented by a slender awn about 20 mm. long and twisted in the lower part. Pedicelled spikelets 4 mm. long, broader than the sessile. Lower involucral glume slightly convex, many-nerved, armed with spreading marginal bulbous-based bristles up to twice as long as the glumes, hairy between the bristles and on the dorsal surface, with a smooth shallow pit; upper slightly longer than the lower, broadly oblong, acute, 3 nerved, ciliate on the margins. Lower, floral glume oblong, obtuse, hyaline, nerveless, sparingly hairy; upper almost thread-like. Anthers yellow, filament forked, one branch bearing one anther, the other branch again forked.—Plate 1.

The pits observed in the sessile spikelets contain a viscid substance. It is not impossible that the latter plays a part in pollination.

Habitat: Found by C. McCann in the village and on the Tableland of Panchgani, Satara District of the Bombay Presidency, November 1925.

Dichanthium McCannii, Blatter, *spec. nov.* (*Andropogonœe Amphilophiastrae*).

Dichanthio armato, Blatter and McCann (=*Andropogon armatus*, Hook f.) recedit praesentia ligulae, numero racemorum, magnitudine spicularum, nervis glumæ involucri inferioris spiculae sessilis, gluma involucri inferiore spiculae pedicellatae alis praedita, aliis ex descriptione patentibus.

An erect tufted grass; stems up to 45 cm. long, slender, simple or branched from about the middle, glabrous, shining, nodes densely long-bearded; internodes up to 7 cm. long. Leaves up to 10 cm. by 6 mm., linear-lanceolate, broadest at the base, amplexicaul, covered all over with bulbous-based hairs which are much longer at the base for about 15 mm; sheaths lax, covering the internodes for ½ and more, glabrous except on the outer margin and the upper third of the whole sheath which are covered with bulbous-based hairs; ligule narrow, 1 mm. broad, made up of bristles united at the base. Racemes solitary or 2, up to 37 mm. long; the 3 or 4 lowest pairs of spikelets all male and alike in shape; peduncles of binate racemes about 1 cm. long, capillary; joints and pedicels slender, of the lower 3 or 4 pairs of spikelets glabrous, of the rest a line of ciliate hairs all along on one side of joint and pedicel and with a few cilia on the opposite side. Spikelets up to 17 pairs. Sessile spikelets 4 mm. long; callus very short, bearded; lower involucral glume pale, 7-nerved, the central nerve running only half way up, 4 mm. long, not keeled, stiff-haired in the upper $\frac{2}{3}$ (no dorsal pit), margins much incurved, tip subobtuse, purplish; upper involucral glume slightly longer than the lower, broadly lanceolate, acute, margin incurved, keeled on the back, otherwise nerveless, hairy towards the tip along the margin and on keel. Lower floral glume narrowly oblong, rounded at apex, flat, hyaline, nerveless; upper represented by a slender awn, 28 mm. long, twisted in the middle third. Pedicellate spikelet 1 mm. longer than the sessile and broader. Lower involucral glume 5 mm. long, narrowly ellipsoid, acute at apex, slightly convex, strongly 10-nerved, very narrowly winged in the upper third, wings purplish, spinous-serrate with stiff hairs, armed with spreading submarginal bulbous-based bristles which are often as long as the glume, otherwise glabrous; upper involucral glume broadly lanceolate, slightly longer than the lower, 3-nerved, apex acute, margins broadly incurved, outer side glabrous, inner side silky hairy. Lower floral glume oblong, obtuse at apex, as long as the upper involucral glume, hyaline, margins silky-hairy in the upper half, upper narrowly oblong-lanceolate, hyaline, slightly shorter than the lower, apex acute.—Plate 2.

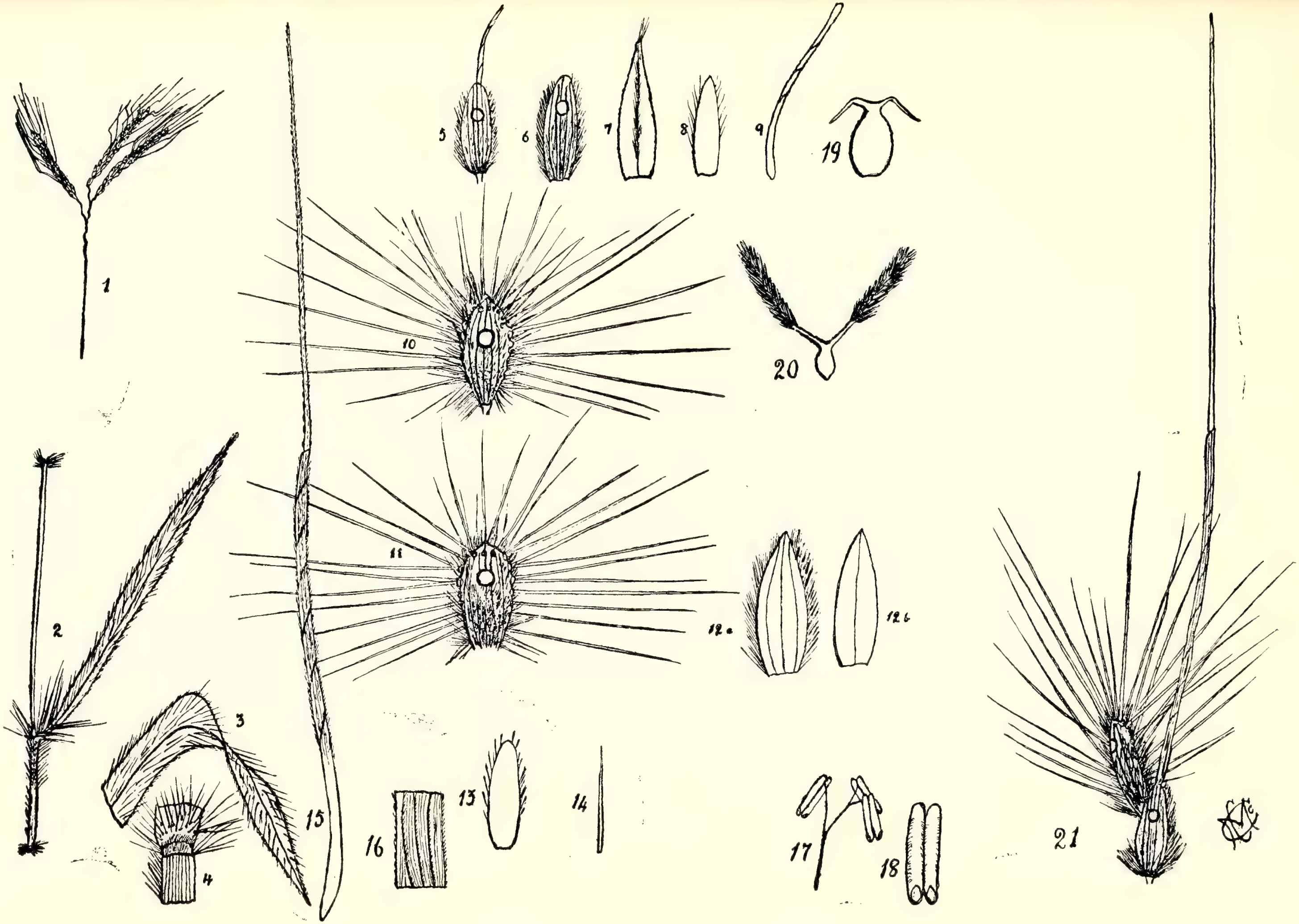
Habitat: Found by C. McCann east or the third Tableland of Panchgani, Satara District of the Bombay Presidency, October 1925.

TEXT FOR PLATE 1

Dichanthium panchganiense, Blatter and McCann, *sp. nov.* 1. Inflorescence. 2. Internode and leaf. 3. Upper part of leaf. 4. Ligule and lower part of leaf. 5. Sessile spikelet. 6. Lower involucral glume of s.s. 7. Upper involucral glume of s.s. 8. Lower floral glume of s.s. 9. Part of upper floral glume of s.s. 10. Pedicelled spikelet. 11. Lower involucral glume of p.s. 12*a*. Upper involucral glume of p.s., ventral side, 12*b*. Dorsal side. 13. Lower floral glume of p.s. 14. Upper floral glume of p.s. 15. Awn. 16. Part of awn. 17 and 18. Anthers. 19 and 20. Pistil. 21. Sessile and pedicelled spikelets.

TEXT FOR PLATE 2

Dichanthium McCannii, Blatter, *sp. nov.* 1. Lower involucral glume of pedicelled spikelet. 2*a* Dorsal side, 2*b*. ventral side of upper involucral glume of p.s. 3. Lower floral glume of p.s. 4. Upper floral glume of p.s. 5 Lower involucral glume of sessile spikelet. 6. Upper involucral glume of s.s. 8 Upper floral glume of s.s. 9. Internode and leaf. 10. Lower part of leaf with ligule. 11 Sessile and pedicelled spikelets. 12. Joints and pedicels.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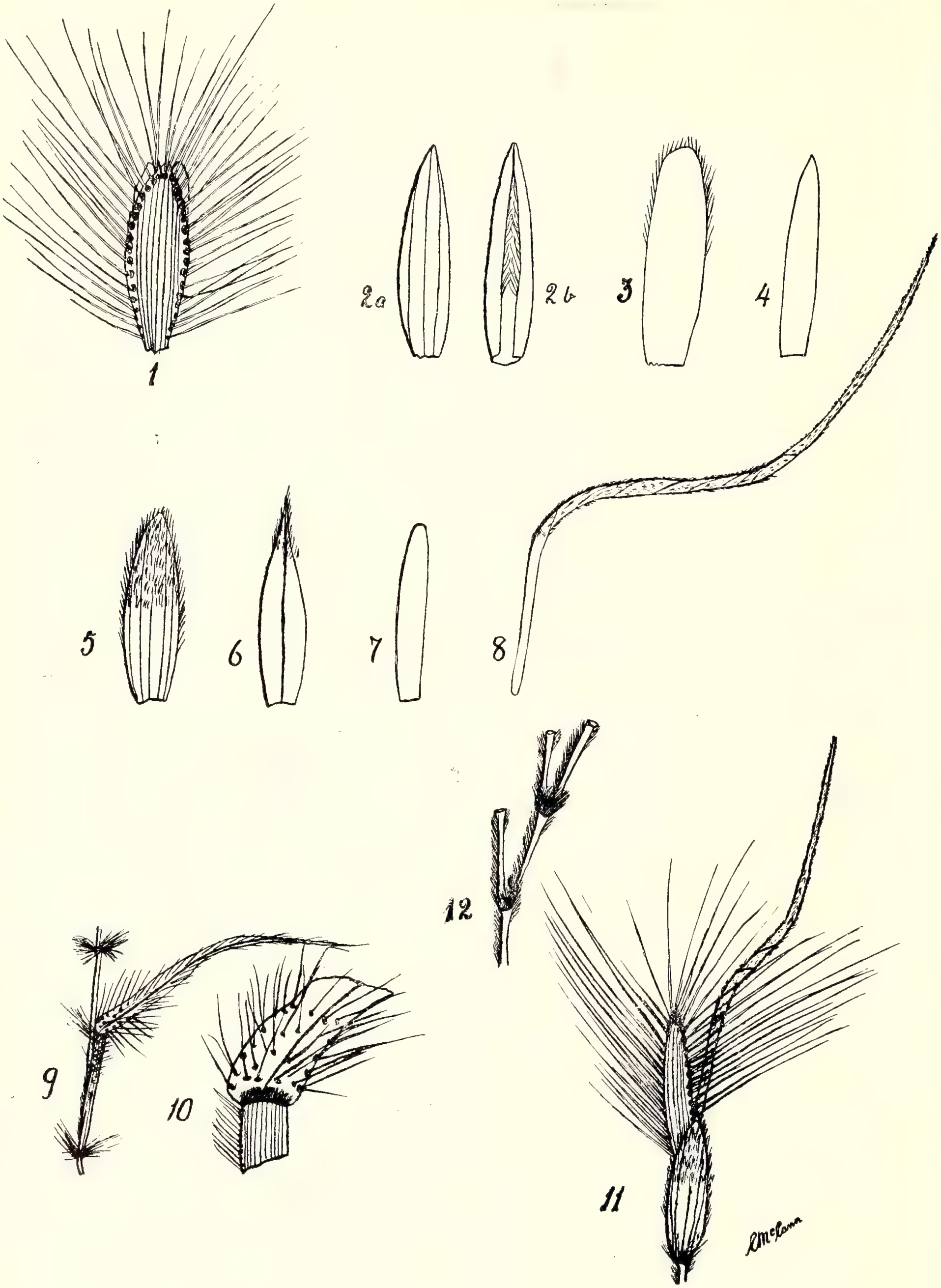
Dichanthium panchganiense, Blatter and McCann. sp. nov.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R McCann

Dichanthium McCannii, BLATTER, SP. NOV.

GAME PRESERVATION IN INDIA

BY

THE EDITORS

Game Preservation wherever it may be undertaken embodies the same principle—the principle that, in order to afford game animals that peace and protection which will enable them to live and reproduce their kind without damage to man, man should only be allowed to damage them under certain rules and should be restricted from ruthless destruction. How is this principle applied in India?

Let us take first the factors which adversely affect the existence of game and then consider the remedies or lack of remedies.

The prime factor adversely affecting the existence of game is MAN. Man affects the existence of game in two ways; firstly as a settler, by clearing the forest and waste lands and driving the game away from its natural habitat; secondly as a destroyer, by protecting his own preserves from intrusion yet pursuing animal life within the fastnesses of its retreat. Disease is a second adverse factor to be reckoned with; rinderpest has accounted for a large number of bison and buffalo in Peninsular India, while foot and mouth disease has in recent years seriously affected game animals in Kashmir and the Himalayan ranges. A third adverse factor might be said to be the killing of game by predatory animals, yet this factor we might set down as a natural check on over-increase, and unless the balance of nature has been upset by extraneous causes its effect on game as a whole is not considerable. The remedy against man would appear to be obvious, namely the provision of extensive areas of absolute wilderness affording harbourage to wild life, and so long as there are refuges safeguarded by their very nature against usurpation by man so long will wild life thrive and maintain its existence, provided there is no epidemic disease. In India the possession of such areas has been one of the main factors tending to the protection of its wild fauna and there should be little danger, for the present, of any of the existing species being exterminated.

Viewed as a whole, therefore, the present condition of game in India would appear decidely good—but for how long will this status be maintained? In some parts of the country, as in the Central Provinces, there has already been serious depletion and in other areas there is an almost complete disappearance of game.

In making a plea for the protection of the wild fauna of the country we must urge that apart from the purely sympathetic motives which should impel man to permit to lesser creatures the right of existence there are other, perhaps less worthy and more material, thoughts and motives which are worth considering. These reasons are put forth on the assumption of course that animal life is worth preserving *somewhere*.

From the scientific standpoint there are innumerable investigations —anatomical, physiological, ecological, geographic, taxonomic and evolutionary, which can only be made from the study of animal life. Biology has already produced many conceptions of practical and educational value. The role of the parasite, the predator, the scavenger, in the economic web of life has, besides its purely educative significance, a not wholly useless application to social relations.

And what about the purely economic aspect? Even predatory animals have a distinct value as a controlling influence against over-population by species whose unrestricted increase would adversely affect the interests of man. Again there is the utilization for man's benefit of animal products, such as furs, hides and horns, which in themselves present a valuable economic asset and are in themselves a plea for the conservation of the sources of supply. Have these economic possibilities been exhausted? A few years ago Insulin, that priceless boon to the diabetic, was discovered in the liver of a shark. Who knows what animal products yet remain to be discovered which will be of priceless value to man?

The principle of conservation being admitted, what are the methods to be employed? The principle is the same in every country, the methods to be employed must vary in every country and will probably vary in different parts of the same country.

Let us consider some of the different methods of conservation in vogue in different parts of India.

In the United Provinces shooting rules close and open shooting blocks for alternate fortnights. This system provides and ensures fortnightly periods of constantly recurring rest. In the Terai type of jungles, where shooting blocks are small and game can be very thoroughly disturbed by a line of elephants beating them day after day, the system is an absolute necessity.

In the Central Provinces the forests are parcelled out into shooting blocks usually of a large size. One block, usually a central one, being reserved as a Sanctuary; this, coupled with the extensive size of the blocks, secures game from undue disturbance. There is here, and in other parts of India also, a strict limit to the kind and number of animals which may be shot in a given block, and, in addition, an individual limit is imposed on all sportsmen, whether exempted from permits or not.

In Southern India the game laws are not applicable to the various provinces as a whole and in certain areas no game laws exist. The Nilgiri Districts and those parts of Coimbatore and Malabar which are so effectively controlled by the Nilgiri Game Association are the only areas with special laws excepting the areas known as reserved forests where the number of animals that may be shot is controlled by license.

The position as regards game in Assam is simple; here the game areas are divided into waste lands, reserve forests, and hill forests. The immense areas of waste land which existed at one time are now being rapidly cultivated by immigrant settlers or used as grazing lands by an invasion of buffalo-keeping Nepalese, so that game in these lands is rapidly losing ground. In reserve forests shooting is controlled by license. For the better protection of rhinos, large areas of grass and swamp land have been included in these reserves and treated as sanctuaries. In the hill forest areas conditions are steadily approaching those obtaining in waste lands where an increasing human population is gradually driving game from its quondam preserves. Whilst game in Assam will be less and less exempt from molestation as cultivation approaches forest boundaries, it must be admitted that there is little danger of game in Assam becoming extinct for a great many years so long as extensive forests continue to exist and to provide safe harbourage to game.

The conditions prevailing in Assam may be applied to India as a whole. On broad principles land may be classified in three main zones—urban areas, agricultural areas, and forest and waste areas. As far as animal life is concerned we cannot expect its preservation in urban lands. Cultivated areas with their domestic animals and crops provide at once an opportunity for a conflict between man's interests and those of the wild species, and in such land the plea for protection cannot carry weight. We come finally to forest areas and waste lands where, as shown, excellent laws suited to local conditions have been framed for the protection of wild life yet nevertheless game is decreasing where once it abounded.

Existing game laws are excellent in themselves but it is in their efficient application that the trouble arises. As far as the agency of man is concerned there is no mystery attached to the causes of trouble. Firstly while the license holder is restricted by the terms of his license from doing undue damage, the poacher is affected by no law. He slaughters indiscriminately everything that he sets his eyes upon, regardless of sex, age, or season, he sits over salt licks and water holes, indulges in night shooting and does all that he should not do. Secondly emphasis must be laid on the great increase in recent years in the number of gun licenses issued which increase is producing, and will continue increasingly to produce, its inevitable effect on game in forest areas and lands immediately adjoining. Thirdly there is a mass of unlicensed guns carefully concealed but constantly used, and there is also the loaning of fire arms by accommodating licensees to friends and retainers, and finally there are the professional trappers and gangs of men with dogs who slay and devour all that falls before them. Those in control of forest areas cannot be altogether exonerated for the ineffective application of the rules. Conservators of Forests and Divisional Forest Officers are not necessarily interested in game preservation, and in addition there often exists the clash of interests between the sylviculturist and the game protector, for game can do considerable damage to young teak and other valuable forest timbers.

If the game in reserved forests and sanctuaries is to be protected a more rigid application of the laws is necessary—the stimulus for which might be obtained by an executive order from above. Much might also be effected by co-operation with the police since every constable is in law 'a forest officer.' A more liberal system of rewards for the detection of forest crime, particularly of poaching, is another point worthy of consideration.

Rewards are far too rarely given and very rarely indeed in poaching cases; the detection and capture of a poacher who is armed often involves danger and there is no class of forest crime the detection of which merits to a greater extent the granting of reward. It is evident that much of the poaching that is done in forest preserves is carried on for profit. It is significant that the decrease of game in certain areas has corresponded with the increase in the export of skins, principally of bison, buffalo, sambhar, etc. Bison, chitai and sambhar hides are openly sold in the bazaars and there is nothing to prevent these sales. If the poacher is deprived of his market the temptation to kill would be largely removed and it would appear that there could be no possible objection to a general law throughout India forbidding the sale by unauthorized persons of any portion of big game animals—whether hides, horns or meat and with adequate penalties annexed for those who break the law.

As to the question of gun licenses, it may be assumed that in 99 cases out of 100 they are not obtained for the purpose for which they are granted as it is the merest fiction to suppose that the guns are used exclusively for crop protection, which is the only legitimate purpose to which they can be put. While the reduction in the number of licenses may perhaps be a difficult matter, it would seem a perfectly fair proposition to have all the 'crop protection' guns called in during the hot weather when there are absolutely no crops to protect. It is during the hot weather, when water is so scarce and the jungles are so thin, that 80 per cent of the damage is done. It has been found useful, where gun licenses are required solely for crop protection purposes, to have several inches of barrel removed. Lastly a suitable penalty might be imposed for the use of a gun except by the license holder in person.

The formation of suitable game sanctuaries has been proposed by many as a solution. Game sanctuaries to be effective must fulfil the following conditions: They must be fairly large, must possess a perennial water supply and must as far as possible be protected against fire and, what is most important, they must have a special staff to look after them. Each preserve will require well-paid watchers with a game warden over them—the game warden should be well paid and given considerable preventive powers. The case for the game warden and his special staff is that many forest officials have neither the time nor perhaps the inclination to apply themselves especially to game preservation. The exploitation of timber and forest produce is annually increasing and forest officers find it more and more difficult to get away from work which brings revenue so as to be able to pay sufficient attention to a question which in this material age is considered to be one of subsidiary importance. A game warden requires special qualifications and besides being a sportsman must also be a naturalist with a knowledge of the ways and habits of the animals he is called upon to protect. The objection to the game sanctuary is that it is expensive both as regards the extent of forest land which must be sacrificed for the purpose and as regards its maintenance by a well-paid warden and an unbribable staff. Besides it may be maintained that a long period of protection in the same area is probably a mistake, Nullahs maintained as sanctuaries in Kashmir for considerable periods were found, on reopening them to shooting, to be almost empty of game. Lastly an 'unbribable staff of subordinate game watchers' would be difficult to procure. The Nilgiri Game Association which, at considerable expense, maintained a staff of seventeen game watchers, abolished the system as these were found to be quite useless and their duties have now been taken over by ordinary forest guards.

The whole question of game protection and the tightening up of the laws affecting it is in the main a question of money. The formation of a special game protection fund in the various provinces might be well worth considering. The fee for shooting in the splendid jungles of the Central Provinces is Rs. 9 per mensem. This paltry sum is to cover the cost of a special guard who often acts as a sort of orderly to the permit holder. Game protection is of interest to the sportsman and it is right that he should contribute towards it. Shooting blocks might be classified as (*a*) the very highest class, (*b*) good blocks, (*c*) poor blocks. The permit holder might be charged Rs. 1-8-0 per day for (*a*), Re. 1 for (*b*) and annas 8 for (*c*). When one considers what people have to pay for sport in other parts of the world, this is not a suggestion that would be seriously opposed even in India where only the poor reside. In addition a special charge might be made for shooting bison, buffalo and the more sought-after species of game. The money raised by these means should be earmarked for game protection. The formation of such a fund might be sanctioned by the Local Governments and applied for the purpose of supplementing rewards to forest guards, to paying informers, poisoning wild dogs and vermin, killing crocodiles in jungle pools, improving scanty water supplies, etc., in fact all measures which might be helpful to game. It would be a simple matter to calculate by a perusal of the permits issued in past years what sum the proposed scale of fees would bring in in a given district. Whilst the measures proposed above might not maintain wild life at its present level they would, we consider, have a beneficial effect and help to retard the process of depletion now going on.

The above article was written originally for publication in the *Times of India*. As it proved too long for the purpose the Editor of the Times published a resumé in a leader which appeared in the paper on July 7.

The following note appeared in the *Times*, London, July 12, in reference to the leader published in Bombay :—

'Any further proposals for preserving game in India as suggested in Bombay are likely to be viewed with the greatest suspicion and disapproval by the cultivating classes. Large game is already carefully preserved in many of the Indian States whose rulers are usually ardent shikaris, and in British India the Forest Department controls most of the game areas. In these, shooting is restricted by the issue of licences and the number of heads that may be bagged.

The depredations of the larger beasts are one of the most serious handicaps that the ryot has to face. Hundreds of thousands of plough and milch cattle are carried off every year by tiger and panther, while the number of human beings who fall a prey to man-eaters is still very considerable. Only last year a man-eater was at large within 50 miles of Madras and was reported to have killed six persons.

Besides the loss of cattle there is the damage done to crops, which in many parts of India is very extensive. Wild elephants are well known as the most destructive of creatures. They will tread down or tear up three or four times the area they eat of such favoured delicacies as cardamoms. It is usually permissible to kill them when they are found doing damage on private land, but it is no easy task to do so. Occasionally a small owner at the foot of the hills may make a lucky *coup* by digging an elephant pit in his land and capturing a small tusker which is worth more than his field, but in an ordinary way the elephant is looked upon as a sacred nuisance. Wild pig do a great amount of damage to sugarcane, and many a weary cultivator spends the whole night on a "machan" among his canes trying vainly to scare them away with horn and tom-tom.

One of the most popular of the provisions of the new Arms Act was the reduction in fees for the possession of muzzle-loaders for the protection of crops and the greatly increased facilities for obtaining licences given to the agricultural classes. Previously, when the losses of cattle from tiger or panther became intolerable and there were no guns available, a whole village would turn out with spears, sticks and drums and surrounding "stripes" or "spots" after his meal, would literally poke him to death.

The cattle mortality returns show no such decrease among them as would justify any further protection of the felines. In fact in the last few years an increase in the number of tiger has been reported in the Godaveri Agency.'

Game Associations

There are already in existence several game associations in the hills which regulate the number of shooting licences issued in the area they control. The Nilgiri Game Association which has been in existence for many years has done very useful work in protecting sambur, bison, etc., and has also spent quite a large sum in stocking rivers with imported trout. Pulni Association, started about 15 years ago, is doing similar good work. Both associations work under the auspices of the Local Government.

So long as the innumerable jheels of Northern India and the tanks of the south receive their supply of water there is no fear of any diminution in the myriads of duck and teal which flock to them every cold weather. The Indian is not likely to change his food supply, and so long as he grows paddy so long will the opportunities for snipe-shooting which India affords be unequalled elsewhere.

As cultivation in the dry tracts increases, it is inevitable that the herds of black buck and chinkara which roamed over the waste lands in former days should diminish, but there will always be uncultivable areas which will form a refuge for them as well as for partridge and sand-grouse and the innumerable other small game of the Indian plains.

The days are yet far off when anything in the way of a National Park to preserve Indian fauna is either called for or practicable. An extract from the petition of a ryot sums up the present situation :—
' A reserve forest in the proximity of the village is the nursing ground for all sorts of forest beasts, particularly that species of animals that exist by the wild destruction and hasty consumption of the crops of innocent but hard-working farmers. No human endeavour, however ingenious, could scare them away ; but if done they come with renewed vigour and far more formidable companions. The declared enemies of the farmer, the cheetas, the leopards, undertake a perfect crusade against my sheep and goats, more particularly my life-giving bulls and other cattle.'

EDITORIAL

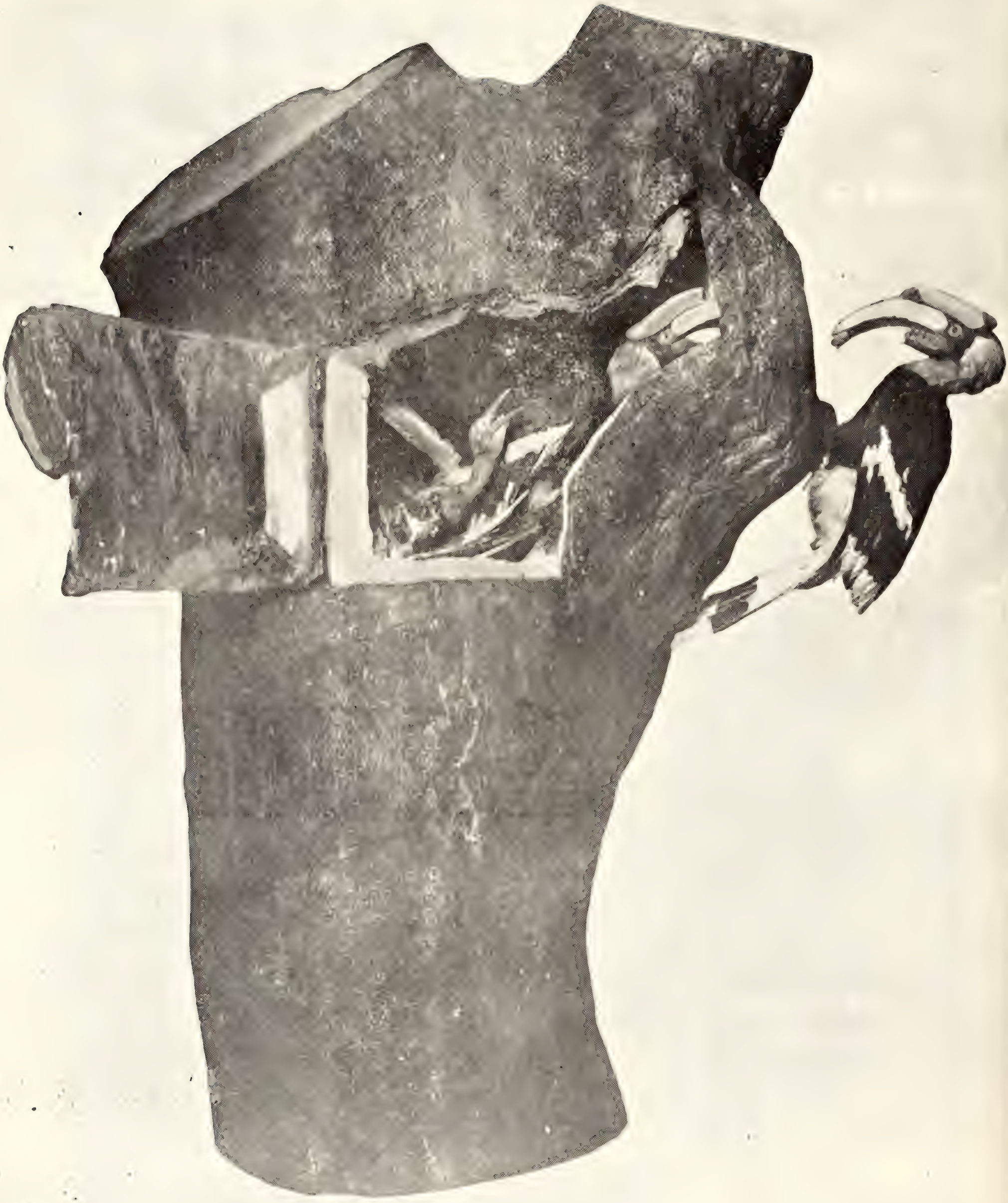
We have to apologize to members for the long interval which elapsed between the publication of Part 4 of Volume XXXI and Part 1 of Volume XXXII. The delay was due to unfortunate labour troubles in Madras and we congratulate both the management and the men on the termination of the strike. We hope such troubles will not occur again and we have the management's assurance that they will be able to print another journal—a successor to this—before the end of the year. If they are able to do so, we as Editors shall have fulfilled the contract the Committee set themselves out to perform, namely the placing in member's hands of four Journals in a year. The Society's prospectus states that the Journal is brought out as near quarterly as possible but this must be modified, and modified not because of recent happenings in the Press but because of the want of material for the Journal. We want more Miscellaneous Notes. We want members who have been on big game expeditions, or have made a study of the fauna or flora of a particular part of India or in neighbouring parts to share the results of their labours with, and relate the story of their travels to, other members of the Society and we want the medium to be the Journal. We will provide, free of cost, copies of the article for the author's private distribution and we welcome illustrations and are willing to publish as many good illustrations as we receive. This brings us to the question of the quality of a good many of the illustrations we produce. We do not know what members' opinions are but for ourselves we are not satisfied. We ought to produce better results. Is it the fault of the Indian block maker ? or of the art paper ? We try to be patriotic and in India support Indian industries. We print the Journal in India and in consequence have to pay duty at the rate of 30 per cent on cost should we print our illustrations at home and bring them out here for insertion in the Journal. If however we were to print the Journal at home there would be no duty to pay on the illustrations. They would then be part of a book and books are admitted free of duty. It is only if you print in India that you pay duty on the paper and the type used in producing the book.

This again brings us to the subject of books. By the time this Journal is in members' hands there should also be in the hands of many of them the fourth edition of Col. Wall's *Poisonous Terrestrial Snakes of our British Indian Dominions* and the first edition of Col. Evans' *Identification of Indian Butterflies*. As regards the former, the third edition has been out of print for a long time now and the issue of the fourth edition will meet a want. One is always liable to come across snakes in India and it is a good thing to have by one both Col. Wall's book and the chart. With these two the veriest tyro can tell whether a snake is poisonous or not and if poisonous can tell exactly what species the snake is.

We are glad to see Col. Evans' work on the Butterflies of India in book form. It seems a long time since the present Honorary Secretary asked Col. Evans to write a child's guide to butterfly collecting in India and it seems a long time since those early interesting and instructive pages appeared. The plates which have been published in eleven parts of the Journal have undoubtedly been prized, appreciated and looked out for but the pages of description—full of necessary abbreviations and without glossary or explanation have—with all apologies to the writer—looked deadly dull to the non-entomologist. Illustrations, keys, introduction, glossary and simple explanations now appear together in one book and the man who knows nothing can cease from caring less and by the aid of Col. Evans' book interest himself in identifying butterflies which he has seen for years but has not troubled—because it was a trouble—to find out the name of. We take this opportunity of thanking both Col. Evans and Col. Wall for the trouble and care they have taken over the publication of these books.

We are getting on well with the painting of the plates which will, in addition to providing the charts illustrating the Common Birds of the Plains of India, illustrate the book on the Common Birds of India we hope to issue next year. We shall give coloured illustrations of no less than 210 birds and by means of three colour or offset method of reproduction and using the same block for both book and chart illustrations, we are confident we shall achieve what has hitherto been regarded as the impossible and produce a cheap well-illustrated popular book on the Common Birds of India.

It will be in all probability a year before the book is published and we would



NEST OF THE GREAT INDIAN HORNBILL (*Dichoceros bicornis*).

Photograph of a nesting group in the Natural History Section, Prince of Wales Museum.

ask members not to be impatient. We hope that this year we shall see the publication of Mr. Whistler's book on Indian Birds, a popular work in the publication of which our late Honorary Secretary, Mr. W, S. Millard has interested himself. We also learn that the Madras Government propose to issue a book on the Common Birds of Southern India, the authors of which will be Messrs. C. M. Inglis and Major H. R. Baker.

THE NATURAL HISTORY SECTION OF THE PRINCE OF WALES' MUSEUM

As members are aware the Society has accepted responsibility for the working of the Natural History Section of the Prince of Wales' Museum in Bombay and the exhibits there are the property of the Society, being the gift either of members of the Society or paid for out of monies so provided. The staff is for a large part paid partly by the Society and partly from funds provided by the Government of Bombay. The administration under the Trustees of the Museum is conducted by a special Board of three Trustees, two of whom have been appointed by the Committee of the Society and the third elected by the Museum Trustees from amongst their own number. Members therefore have an interest in the finances of the Natural History Section of the Museum and for their information we give the following extract from the Annual Report of the Section for 1926–27 :—

Government Grant. The maintenance and operation of the Natural History Section for the fiscal year from April 1, 1926 to March 31, 1927, were provided for from the grant of Rs. 23,500 received from the Government of Bombay. The opening balance at the Bank on April 1, 1926, amounted to Rs. 4,411-7-8, the income during the year from interest and other miscellaneous receipts amounted to Rs. 678-11-5.

In accordance with the terms of agreement existing between the Natural History Society and the Board of Trustees, Prince of Wales' Museum, a contribution of Rs. 10,537-8-0 was made by the Society being the half cost of the salaries of the Curator and Assistant Curators.

Income and Expenditure. The total income of the Natural History Section for the period under review amounts to Rs. 28,590-3-1. The disbursements may be classed as follows :—Establishment, including Board's contribution to the Provident Fund, Rs. 20,941-13-0, Taxidermy Department Rs. 967-14-3, Show Cases and Equipment Rs. 978-4-0, Miscellaneous Charges Rs. 1,694-14-2, Curator's Deputation to America Rs. 2,500, Collecting Expeditions Rs. 139-2-0, making a total expenditure of Rs. 27,221-15-5.

It will be noticed that only Rs. 978-4-0 has been spent on Show Cases and Equipment and Rs. 967-14-3 on Taxidermy. Well, the Curator works wonders with very little money but even he and his staff could not have prepared the exhibits of the past twelve months on an expenditure as low as that shown.— The help given by Vice-Patrons of the Society is not shown in the preceding statement which apart from the Society's contribution to staff salaries only shows the monies contributed by Government and interest, etc., thereon.

Most of the activities of the Section in the past year have already been commented on in our Journal, either in the Editorial or in the reports of our meetings. In the present number under the latter heading appears a reference to the first of the four group cases illustrating life zones in the Indian Regions, i.e. the desert, rain forest, high altitude and plains. The groups are to be built on the lines of a diorama with curved painted backgrounds. This mode of scenic representation is being generally adopted by the more advanced museums in Europe and America as a direct means of arousing interest of the visitor and thereby more effectively instructing him. By a combination of transparent and opaque painting, of transmitted and reflected light and by contrivances such as screens and shutters a diversity of scenic effect is produced. Besides illustrating the fauna and the flora of given areas these groups will illustrate typical Indian landscapes which will give the visitor not only the idea of the diversity of animal and plant life of the country but also of its diversity of its scenery. We have also referred in a previous Journal to the group illustrating the nesting habits of the Great Indian Hornbill. As the father bird employed in feeding the mother and her young, is no other than the mascot of the Society who for over twenty-five years played cricket behind the Honorary Secretary's chair and extolled the advantages of a life spent in total abstinence from the consumption of water, we publish an illustration of the nesting group.

The annual report also refers to what has been done to interest visitors to the Museum in Reptiles. Instead of being content with exhibiting representations of snakes, the Curator is working with the idea of illustrating the habits of snakes. The viviparous snakes are represented by a Russell's Viper with its new-born brood of thirty-four young. The oviparous snakes by a Cobra which is seen occupying a deserted ant-hill; the snake is shown with its clutch of eggs. An inset shows the development of the snake from the earliest stage to the time when it is ready to free itself from the egg chamber with the aid of its egg tooth. The third case illustrates how snakes poison their prey. The Saw-scaled Viper or Phoorsa is shown in the process of swallowing a Desert Gerbille. A dissection showing the poison apparatus of the snake and the models of the type of fangs and a unique photograph showing a drop of poison emerging from the tip of a Russell's Viper's fang complete the lesson which the case tends to teach. The plants, grasses and other accessories to these groups have been beautifully reproduced in wax and lend greatly to their attractiveness and interest. Full explanatory labels in English and Marathi have been used in connection with these cases.

An acquisition to the series of exhibited Insects is the new case illustrating House Flies and Disease. A very beautiful model of the House Fly was presented to the Society by Mr. F. V. Evans—one of its Vice-Patrons. This has been introduced into the case and supplemented by models of the eggs and the larval and pupal stages of the fly prepared in the Society's laboratory. While a fly-ridden tray of sweetmeat shows better than words can one of the means by which the germs of disease are carried by flies to man.

Mr. Prater has been ably backed in his work by his assistants—Mr. Salim Ali has increased the reputation of the Society by the educational work he is doing in our schools. Mr. McCann seems to imbibe ideas on modelling as though he were still imbibing his mother's milk and though Mr. LaPersonne is having a respite from travelling and congratulating himself on no longer being in Eastern Persia, he is thinking with envy of the fortunate American Naturalists who are to make a collecting tour in Nepal next cold weather.

It is rather a reflection on the British in India that the best and most representative exhibits of the Fauna of India should be found—not in Indian Museums and not in English Museums but in American Museums. It is not the American Government which puts the American Museum in such a favourable position and there is no need for the British or Indian Governments to do what the American Government does not do, but the American Museums are able to do things because the people of America take an interest in the work the Museums do, and so find the money. American Museums one might say have all the money they can spend. What a difference to India: Were it not for the Government of Bombay we should have no Natural History Museum for the public (it is no argument against, that but for the Natural History Society the Government would have had no Museum to spend money on!). The Natural History Society provides—thanks very largely to its members—the material and the supervision, but raw material is no use without money to turn it into interesting and instructive exhibits and unfortunately the individual in India does not consider there is any call upon him to provide funds for Natural History Museums. One reason of course is that in America there is money and in India, according to the politician, there is none. Is another reason lack of appreciation of existing Museums? Would people interested in Natural History subscribe towards the cost of exhibits if they knew that not only would the exhibits vie with those in American Museums but also knew that the exhibits provided out of their money were housed in a Museum built for the purposes of a Museum—built to serve the purpose it was intended for—built by the architect to meet the requirements of the curator, the architect building and elaborating on the plans of the man who has to make use of the building? We hope to deal more fully with this in our next issue but what a difference we foreshadow!

We publish in this issue the Memorandum and Articles of Association necessary to enable our Society to be registered under the Scientific Societies Act of 1860. We shall be very grateful to members if they will post us their consent to the proposed articles as early as possible and also any suggestions which they consider will be of help to the working of the Society.

There is a flaw in our constitution, or in our management, or is it that the spirit of co-operation is lacking amongst our members?

We ought to have branches, local meeting places, places where up-country members could meet and where members experienced in Natural History conditions in India can give practical assistance to the young member, beginning his career in India. We want Field Naturalists' Clubs, affiliated to or part of this Society in every important cantonment in India. We want each member to be as keen on getting fresh members for the Society as he would be to put his best pal on the real thing—and a certainty which will benefit him and his friend the more, the more friends he induces to go for the dead cert. You can't do such a thing on the Race Course but you can in this Society, but what do we find ?

Many years ago—when Sir Henry McMahon was A.G.G. at Quetta—a Quetta Natural History Society was started and was not affiliated to the Society. The only link between us is that Quetta has our Journal and the Curator of the Museum received his early training from us. We referred in a previous editorial to the formation of a Nature Study Club or Field Naturalists' Club at Poona, a station close to Bombay. We gave the new undertaking our blessing but it was formed without any help from us and without any reference to us. The idea of a branch or affiliation with the Bombay Natural History Society never seems to have occurred. And now we hear—not officially and not directly, but casually—that Karachi has formed a Natural History Society. Well to this new Society we also give our best wishes and promise all the help we can, but surely there would have been an advantage to all concerned had this new Society been a branch or affiliated in some way to our Society. We propose writing to the promoters and putting this query to them but whatever the answer may be it will still leave, as an unsatisfactory blot on the Society, the fact that new Natural History Societies are started in India without any one thinking it worth while to consult the Bombay Natural History Society. When new associations for the encouragement of the study of Natural History are formed, one would imagine that those approached are those people resident in the locality who are interested in the Fauna and Flora of India. Are none of these members of our Society ? If none are—what is wrong with us—why have we failed to attract them ? If they are members, why have they failed to link up the new Society with the old or rather why have they failed to make any attempt to do so ? What is wrong ? Something must be, and we appeal to members to tell us. The Committee are not composed of pachyderms neither are they composed of those who are missing the seventh skin and cannot bear criticism. They are the members' representatives and it is up to the members to let their representatives know what is wrong with the structure of the house and the mentality of those who look after it.

We said we wanted each member to be keen on getting new members—we have issued this appeal time and time again. We pointed out that last year we had obtained 204 new members and lost ninety-seven. We asked members to try and better that—there was nothing special about last year's result—no organized attempt to beat up recruits—merely one member or another showing the Journal to friends or telling friends that if they want the results of their skill and shikar turned into trophies, which would for a small sum be a pleasure for life, or telling hard up acquaintances that if they wanted books on Indian Game Birds cheap, they should join the Society. That was all that was done but why is it not being done now ? Or if it is being done now why is it a failure ? What is wrong ? Our failure to publish a journal for five months is not our fault and members will get their quota by the end of the year.

We ask why is it not being done now ? and we ask with reason. We have lost through death and resignation this year forty-five members. We have gained 113 new members. Splendid ! Yes—compare it with last year and then remember that it is the result—not of the member asking the man who is keen on Natural History to join the Society—but the result of the Honorary Secretary and his staff drawing a bow at a venture and asking men who they know are interested in the progress of India but who may not have the slightest interest in nature, to join the Society. If such requests bring forth good results what might not one expect in the way of results from members asking those who are interested in Natural History to join ? There is no necessity for any set form of application but each of the present Journals contains a form and we hope each will be made use of.

MISCELLANEOUS NOTES

I.—TIGERS AND ELEPHANTS

Referring to the note by Prince Victor Narayen on page 1025 of vol. xxxi of the Journal, it is surprising that the Cooch Behar shooting records do not chronicle any case of an elephant being attacked without provocation by a tiger because it is certain that in Assam hungry tigers do kill young elephants.

I have known of a female that was captured, lacerated and weak from loss of blood and exhaustion, standing beside her small calf, which had been killed by a tiger, and there was no doubt that the tiger subsequently attacked the mother when she came up and tried to drive it off.

During two seasons' hunting in the North Cachar Hills we caught four or five elephant calves, which tigers had attempted to ham-string, and we destroyed one in the jungle which had been crippled and deserted by the herd without being finished off by the tiger. The above calves were all 5 ft. or over, and were presumably getting beyond the size most easy for hamstringing. There were, it must be admitted, special circumstances in North Cachar because rinderpest had almost wiped out the wild buffalo, bison and pig, and the tigers must have been hard put to it for food, but it is not unusual elsewhere to find the pug-marks of a tiger that has apparently been following a herd on the chance of being able to dash in and cripple a calf before its mother can defend it. We once cornered a herd of elephants in Kamrup but were unable to drive them with men in the desired direction owing to the presence of a fierce old female and so used our trained elephants for the job. They spent three days trying to drive the wild ones, and on each day put up a big male tiger that was hanging round the outskirts of the herd.

Gauhati, Assam.
May 21, 1927.

A. J. W. MILROY.

[An interesting note on the subject of a tiger attacking elephants by Mr. C. G. Corbett appears on page 119, vol. vii of the Society's Journal. From the number of similar instances recorded from time to time it would appear that in thickly afforested tracts it is by no means an uncommon occurrence for a tiger to hamstring and kill young elephants. It is further interesting to learn from the Annual Report of the Uganda Protectorate Game Department for the year ended December 31, 1925, that the lions in those parts also habitually take a heavy toll of young elephants. Eds.]

II.—TIGERS PREFERRING CARRION TO LIVE BAIT

Regarding the note about tigers preferring carrion to live bait, which appeared on page 1025, vol. xxxi of the Journal, I came across an instance of this a couple of weeks ago. I shot a tiger over the carcase of a bear which had died and been carried off by the tiger in preference to a bullock, tied up for his special benefit a short distance away. There is a bare possibility that the tiger had not seen the bullock, but knowing what the tiger is, I think this is hardly possible. While on the subject, can anybody inform me of what use to the common bear obtained all over the plains of India, is the six or seven inch coat of fur he is provided with?

I have heard the reason given that it was to save him from the stings of bees while robbing their hives. I do not think this can possibly be the explanation. If bees had stings six or seven inches long, very few people would cultivate them!

I shall be grateful for a more reasonable theory.

Makri,
Kondagaon P.O.,
Bastar State, C.P.,
May 6, 1927.

W. H. O. SHORTT.

[The shaggy and dense coat of the sloth bear whose habitat is restricted to the forests of peninsular India appears unsuited to the climatic conditions under which he lives. While there is certainly some connection between temperature and the range of animals, climatic conditions and animal inhabitants do not always march together, and the distribution of animals cannot be mapped out into the areas bounded by parallels of temperature since there are plenty of cases like that of the tiger, which is as much at home in a tropical jungle as on the icy plains of northern Asia. EDS.]

III.—A PANTHER COMMITTING SUICIDE

I met with a somewhat unusual experience the other day which might interest readers of the Journal. I should also like to hear of any similar experiences of other members.

I was informed early one morning that a panther was sitting near a tank not far away. I went out and found it lying more dead than alive among some rocks. I put it out of misery and then found, on closer inspection, that the greater part of the near hind leg had been eaten away, evidently by the panther itself as there were no marks of a fight of any sort on the body.

On skinning the animal it was discovered that there were a number of pieces of porcupine quill embedded in the flesh, and it was evidently the excruciating pain of them, festering inside the leg, that had made the panther eat away the affected part, although it virtually committed suicide by doing so, as I do not think it would have lived much longer. You may imagine the extreme state it was in when I say there were a score of villagers watching it from about thirty feet distance when I arrived, and it was taking not the slightest notice of them.

I have heard and read of animals biting away a leg caught in a trap, but this would not mean eventual death to the animal, and I cannot understand any animal going to this extreme to rid itself of even the worst kind of wound.

I shall be greatly interested to hear of any parallel experience.

MAKRI,
KONDAGAON P.O.,
BASTAR STATE, C.P.,
April 8, 1927.

W. H. O. SHORTT.

IV.—THE COLOUR CHANGE, AND SEXUAL DIFFERENCES IN COLOUR IN THE LONG-ARMED SHEATH-TAILED BAT

(*TAPHOZOUS LONGIMANUS*)

I have read with interest Mr. McCann's notes on the Long-armed Sheath-tailed Bat, in the recent number of the Journal. (Vol. xxxi, p. 1030).

I do not, however, agree with the suggestion that the young of this Bat are pale fulvescent and become gradually black with age. I am convinced, from my experience with the species in Ceylon, that the opposite is in reality the truth—that is to say, that the young are dark in their first coat and become gradually lighter and more brightly coloured with age, the adult male becoming light reddish-(almost cinnamon) brown eventually.

Out of ten of these bats, all shot from their 'roosts' in the crowns of cocoanut trees, six were males and four females. The males were reddish-cinnamon-brown in four cases and dark grey in the remaining two, both the latter being certainly juveniles, I think.

The females were all four dark grey, with the exception of one—a very large specimen—which had the grey tinged with reddish. And of two others, both females, shot one evening near Kantalai Tank, one, the smaller, was of the usual dark grey type while the other, an exceptionally large one, was of the same cinnamon-brown shade as is seen in the adult males.

I think, personally, that the cinnamon-brown shades (becoming more fulvescent with age) are the usual colour of the adult males, while the dark grey is the usual colour of the females and young but that the adult female may assume the cinnamon-brown shades in old age.

Much the same colour change may be observed in the closely related species, the Black-bearded Sheath-tailed Bat (*Taphozous melanopogon*). The males of this species would seem to be lighter and brighter in colour than the females and young; and what I take to be the oldest males are again lighter than the general run of males.

In another family of bats—the Rhinolophidae—we also find an analogous case. The young Dekhan Leaf-nosed Bat (*Hipposideros brachyotus*) is, in its first coat, a very dark blackish-brown while the adult has generally a deep reddish-brown coat, which may on occasion turn to bright reddish-or ferruginous-brown. Again this bright colouring is much more common in, but not entirely confined to, the old males.

My own belief, which I have not entirely confirmed yet, is that as a general rule among insectivorous bats, where any differences of colour are found, the young bat is always darker than the adult and that the coat of the adult usually lightens and brightens in colour with age, but that the lighter and brighter shades of colour are assumed at a very much earlier date by the males than by the females.

Mousakande Group,
Gammaduwa, Ceylon.
April 21, 1927.

W. W. A. PHILLIPS.

V.—HABITS OF THE FLYING LEMUR (*GALEOPTERUS PENINSULÆ*)

I have recently had a Flying Lemur in captivity for a week and was able to observe its habits to a certain extent and perhaps the following observations on this comparatively rare animal may be of interest to readers of the Journal. The Lemur was captured by some wood-cutters at Kamounghla, Tavoy District, and through the courtesy of Mr. B. Ribbentrop came into my possession a few hours after capture. Though at first it bit somewhat viciously when handled, the little animal in a very short time appeared to realize the fact that no harm was threatened, and it soon ceased to bite and allowed itself to be handled freely. It proved to be almost if not quite nocturnal, but if disturbed in the day-time could move about freely and did not show any marked dislike to bright sunlight; for the greater part of the day it seemed asleep, either pendant from the branch of the tree I provided for it, or else in a clinging position to the upright trunk of the tree. In either position the head was invariably tucked under the body between the fore-legs and the tail tucked in between the hind-legs, and in both positions the protective colouration of the lemur's fur was most striking and when viewed at even a short distance against a background such as the mottled trunk of the tree, the animal was extremely difficult to discern. It can be easily imagined how very much more effective this protective colouration would be in the dim light of our evergreen forests—its natural home—and the Burmese name of 'Thit Poo' applied to it (meaning literally a protuberance on the trunk of a tree, or a tree knot) rather aptly describes its appearance when asleep. Its movements usually were very slow and sloth-like, and when placed on the ground it proved to be just as helpless as a bat is in a similar position, and not being capable of assuming an upright position could only progress by a succession of short flapping leaps towards the nearest upright object up which it would immediately climb. The animal readily ate ripe fruit and drank milk from a dish, lapping it up much as a dog does, but a variety of insects such as spiders, beetles, grasshoppers, moths, etc., offered it both in the live and dead state were invariably refused much to my surprise. It did not readily eat the small pieces of raw meat offered and apparently the main diet of these animals in the wild state is fruit.

The only sound the animal seemed capable of making was a soft rattle much resembling the sound produced by a pencil-point run sharply across the teeth of a comb. When frightened, this sound was accompanied by a hiss resembling that produced by a snake. The animal died, apparently from some pulmonary disease, a week after its capture.

Hpa In Mine,
Tavoy,
March 2, 1927.

W. S. WOOD.

[The Flying Lemur, also known as the Cobego or Colugo, is one of the most interesting animals of our region. Naturalists have been very puzzled as to its true status; some have placed it with the bats others with the lemurs and others again with the Insectivora. Dr. H. C. Chapman who made a special study of the animal, maintains that it cannot be regarded either as a bat, or a lemur or an insectivore but that it stands alone as the sole representative of an ancient group, the *Galeopithecidæ.* The degree of development of the expansion of the integument by which the creature supports itself in the air, is midway between the bats and the flying squirrels. Not only are its long slender limbs connected by a broad integumentary expansion extending outwards from the side of the neck and body as in a flying squirrel, but there is also a web between the fingers and the toes, while the connection of the hind limbs and the envelopment of the tail in a membranous expansion is comparable to a similar structure in bats. The brain is like the Insectivores. The teeth are peculiar in the singular comblike expansion of the lower incisors. In its food the species appears to be frugivorous rather than insectivorous, as noted by Mr. Wood. Eds.]

VI.—FLYING SQUIRRELS IN TENASSERIM

I am sending for the Society's Museum the skin and skull of a small kind of Flying-squirrel; I caught the little beast alive but could not rear it for longer than a fortnight. It is apparently full grown and extraordinarily small, being only about eight inches in length all over. The tail too is an extraordinary feature resembling a feather rather than the full tail of a squirrel. I noticed that this was always held over the back in true squirrel style. The only other small Flying-squirrel that I have come across in this district is the Striped Petaurista. I remember once giving J. C. Hopwood seven of these latter, and as there were two full-grown squirrels and five small ones I naturally concluded they formed the parents and young of one family. Hopwood afterwards found that they consisted of two mothers one having three young and the other two, and the queer thing is that they were all found in one nest in a bank of earth apparently on the best of terms, and unlike human beings, the two females appeared to have been sharing the same abode in perfect harmony. I cannot say for the male squirrel whether it was a case of two wives as I never met the little gentlemen to enquire.

The Burmans here give rather a peculiar name to the little Flying-squirrel whose skin I am now forwarding. They call it the 'Thimbaw-tha-naya' which means 'the five hundred sailors,' and the legend is that five hundred sailors (of what nationality history recordeth not) landed on the Tenasserim coast somewhere, and saw one of these squirrels and desiring to catch it, the whole five-hundred chased it for a whole seven days but could not effect a capture owing to the squirrel's nimbleness, hence the odd name. I am not too sure that this is the animal the name applies to, as I have heard the same legend in connection with the little striped Palm-squirrel.

Tavoy,
May 14, 1927.

W. S. WOOD.

[The skin sent by Mr. Wood is that of the Pigmy Flying Squirrel (*Pteromys* (*H.*) *belone*) whose distribution is Arrakan, Tenasserim and Cochin China. Eds.]

VII.—ALBINO GORAL (*NEMORRHÆDUS GORAL*) IN CHAMBA

Some albino goral are found in the Chanju Perganah of the Chamba State. They are like ordinary goral except for the colour of their coat which is white. They live at an altitude of 7,200 feet. A pair was noticed about ten years ago and they are multiplying, as six were seen at Christmas 1926 when I was shooting there. I managed to shoot one. It is a good specimen the horns measuring $8\frac{5}{8}'' \times 3\frac{5}{8}'' \times 2''$. These measurements have been recorded by Messrs. Rowland Ward who are setting up the head for me.

Chamba,
April 14, 1927.

RAM SINGH,
Raja of Chamba.

VIII.—IS THE LARGE HORNBILL (*DICHOCEROS BICORNIS*) CARNIVOROUS?

I remember in Myitta (Tavoy District, South Tenasserim) somewhere about 1912 watching one of these great birds calmly extracting and swallowing with apparent relish, one by one, an unfortunate brood of young Mynas from a hole in a tree, while the irate parents vainly endeavoured to drive him off by clinging to his head and pecking him. The Hornbill paid not the slightest attention to this somewhat rough treatment but carried on until he had disposed of the whole brood. The Hornbill was most methodical in his procedure. He would extract a young bird, beat it on the branch of the tree until its struggles ceased, throw it up in the air and catch and swallow it. I was quite close and I noticed that the young Mynas were just getting their feathers. The question arises is this a common practise among Hornbills? or is it a case of individual degeneracy? If it is the former, the Hornbills must do enormous damage among the young of wild birds and should be indicted along with the birds of prey and other nestling destroyers.

TAVOY,
May 14, 1927.

W. S. WOOD.

[Lt.-Col. A. Newnham, I.A., recorded on p. 263, vol. xxi of this Journal the instance of a Grey Hornbill (*Lophoceros birostris*) extracting and devouring young paroquets from a nest-hole in a large siras tree at Jullunder.

A specimen of the species referred to by Mr. Wood which lives in the Society's rooms once caught hold of a rat that had ventured into its cage and was proceeding to dash it from side to side, no doubt with the intention of ultimately making a meal of it, when the squealing victim somehow managed to free itself and to make good its escape. On another occasion a half-grown pigeon was unfortunate enough to transgress into the hornbill's domains and was promptly seized and battered to death against the sides of the cage. The bird was too large to be swallowed and was therefore dropped on the floor. EDS.]

IX.—A JUNGLE FOWL PROBLEM

I was wandering through a shola bordering my estate in April last year and found a portion of the shola was simply alive with Jungle Fowl (hens) and their young chickens. I saw no cocks, but hundreds of hens flew up into the trees and there seemed to be myriads of baby chicks on the ground. While I moved the latter kept extraordinarily still, not a leaf stirred; but if I stood perfectly still for a few minutes they would slowly start moving forward again and the air was full of their little 'cheep,' 'cheep,' 'cheep.' There seemed to be a belt of hens and their chicks moving down the shola, about fifty or seventy-five yards wide. Can you account for this strange congregation of Jungle Fowl?

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE,
April 5, 1927.

RANDOLPH C. MORRIS.

X.—A LOST SNIPE

On March 19, 1927, I was shooting with a friend, B. down a small tributary stream of the Haro River between Hasan Abdal and Haripur. We were accompanied by a local shikari. The stream consisted of a chain of still pools connected by small runs.

A Full Snipe rose and we dropped him, winged, into the middle of a pool. The pool was some fifteen yards in width by about forty yards long. We advanced to pick the bird up, providing ourselves with a long stick for the purpose as he was lying some seven yards from either bank and the pool appeared some feet in depth. As we approached our attention was temporarily diverted by two snipe passing overhead. They flew well out of range and I paid them little attention. At the most I had taken my eyes off the pool for fifteen seconds when I looked at it again and saw that the wounded Snipe had completely disappeared. Had it had time to swim to either bank—it certainly had not—it would have found no cover. The pool was bounded on one side by a smooth perpendicular cliff and on the other by an open mud beach covered only by a few pebbles. There were no surface weeds. The current was negligible. A careful search convinced us that the bird must have been quickly drawn under by a fish.

These pools, I know, contain murrel. The shikari, a reliable local man, told us that the murrel hereabouts run up to seven or eight pounds. The water looked too small to hold anything bigger.

Turtles abound in the Haro River. I have seen no traces of them in this particular stream the nature and size of which seem to eliminate the likelihood of a turtle being the thief.

Just before our attention was diverted to the flying snipe, both B. and I noticed that the wounded bird made two quick attempts to jump. I believe it to be most unusual for a winged snipe to try to rise from open water. Perhaps in this case the snipe saw the fish rising towards it from the weeds at the bottom. The water was clear.

Isn't a murrel usually slow to make up his mind to feed and shy of approach? In this case the thief, whether fish or turtle, was neither one nor the other.

SRINAGAR, KASHMIR,
April 4, 1927.

R. H. STABLE,
Capt. I.A.

[Mr. T. R. Blackley of the Sudan Civil Service describes in the *Field* of May 12 (1927) a recent experience where he shot a brace of teal right and left, which fell into a swamp. Before they could be retrieved, a hawk swooped down and carried off one bird. After a prolonged search the second was found and when pulled out was seen to have been partially devoured by a fish which continued to hold on tenaciously to its prize even when the teal was pulled out of the water by its legs ! The fish is estimated to have weighed about 1½ lbs.

A curious instance is recorded on p. 259, vol. vii of the Society's Journal where a wounded snipe, after a protracted search, was rescued from the jaws of an enormous frog. However, it is very likely that as the pool at which Capt. Stable shot contained murrel, this fish and no other was the culprit in the case.

The murrel (*Ophiocephalus* sp.) feeds largely on frogs that roam about near the surface of the water, and it is probable that while looking for its prey, the fish caught sight of the helpless snipe and lost no time in appropriating it. EDS.]

XI.—'THE ARRIVAL OF SNIPE IN MYSORE'

I read the letter with much interest (No. 11, by Mr. G. V. R. Frend) in vol. xxxi, No. 4, in connection with the arrival of Snipe in Mysore. In this letter he states he shot three Pin-tail snipe in Mysore on August 29, and questions whether they were early immigrants, or possibly birds that had remained over from last season.

In a note by the Editors on this incident, the opinion is stated that these birds were probably 'stay-backs' from the last season—but I should like to state that I do not consider this conclusion to be correct (at any rate as far as the date of August 29 is concerned), and Mr. Frend did not mention that he had obtained any birds before this date in July.

I have watched the north-east migration of birds fairly carefully in the hill districts in Ceylon for some years past, and my opinion is that there is practically always a north-east inclination of the wind (though not always a ground surface wind) some time in August, usually about the time of the full moon, and the first and earliest fore-runners of the various winter migrants practically always arrive in the hilly districts of Ceylon during the period of the August full moon, whenever that occurs. The migrants that appear in Ceylon (though in very few numbers) regularly during August are as follows :—

The Common Sandpiper (*Tringa hypoleucus*).
The Grey Wagtail. (*Motacilla cinerea melanope*).

The Blue-tailed Bee-eater. (*Merops superciliosus javanicus*).
The Brown Shrike. (*Lanius c. cristatus*).
The Pin-tailed Snipe. (*Gallinago stenura*).

In this list the Pin-tailed Snipe occurs, and occasionally the early snipe appear to be young birds with their full plumage hardly matured, though generally I expect the first and early birds to arrive would be disgruntled males, that for some reason or other have not paired properly during the season.

One often hears people state that birds that have been pricked by a shot, do not undertake the arduous migratory flight when the mating 'urge' arrives in April, but my own experience is that this 'urge' is so strong; that whether they were wounded or not, unless the cells of the brain that govern the homing-instinct were affected, they would endeavour to undertake the journey, and would of course fall by the way, more likely than not, a meal to some bird of prey, watching for the weak ones following behind the migratory flight.

KANDY,
April 18, 1927.

GEORGE BROWN.

XII.—ADDENDA TO THE AVIFAUNA OF SIND AND OF BRITISH INDIA

1. Ammomanes phœnicura zarudnyi.

Since I wrote the *Birds of Sind* (*Ibis.*, 1923, p. 19) I have discovered a specimen of this desert form of *A. phœnicura* which was collected by Blanford south of Sehwan, on December 12, 1875. He no doubt obtained it in the hills or foothills of the Kirthar Range and passed it over as the young of *phœnicuroides* from which however the black band across the tail among other differences suffices to distinguish it. Its status is doubtful, possibly a resident possibly an elevational migrant from Kelat. The specimen is in the Tring Museum. This race has been recorded from Baluchistan.

2. Sylvia curruca halimodendri.

A specimen of this pale form of Lesser White-throat was obtained by Mr. Salim Ali at Phulji, Larkana District, on December 22, 1926 and sent to me for identification. I have already recorded this race in Persian Baluchistan but this is the first record in India proper. This race is much paler above than *Sylvia curruca affinis* and is about the same colour as *minula*, however in measurements and wing formula it is the same as *affinis*. Prof. Sushkin has divided these pale White-throats still further and gives as the distribution of *halimodendri* from Zaisan Nor, west to the steppe region north of Aral Sea, while his new form *telengitica* is said to inhabit the basin of the Achit Nor and South-east Altai in Western Outer Mongolia. The only specimens I have examined from anywhere north of India are those collected by Przewalsky in Ala Shan and N. Tibet and these correspond with the description of *halimodendri*, and seem to be quite the same as the Sind and Persian-Baluchi birds and therefore until one can see specimens of *telengitica* I keep them all under the above name.

LOWESTOFT,
March, 1927.

C. B. TICEHURST,
M.B.O.U., F.R.G.S.

XIII.—CORRIGENDUM TO FAUNA OF IRAQ

In the Journal for May 1926 I recorded the jay from Dohuk (Additional Notes on the Birds of Iraq) as *Garrulus glandarius atricapillus*; I have recently re-examined all the jays from Palestine, Asia and Caucasus and I find the Dohuk bird is much nearer the Caucasus one. It is greyer above and below than *atricapillus*, the Palestine bird, and less pure white on the forehead and ear coverts. The Dohuk Jay should stand as *Garrulus glandarius krynicki.*

LOWESTOFT,
March, 1927.

C. B. TICEHURST,
M.B.O.U., F.R.G.S.

XIV.—BIRDS EATING BUTTERFLIES

Mr. Hopwood's letter in No. 3, vol. xxxi reminds me that in the Teesta Valley I once saw a Red-legged Falconet catch and eat a Butterfly. It was a female *Papilio memnon* absorbing nectar from a flower and I was in the act of sweeping a net at it when the falconet swiftly passed in front and left no butterfly for the net to collect. I was only just able to turn my eyes from the flower to the bird in time to see the butterfly's wings fall from each side of its beak as it flew to its perch on a tree to swallow the body.

MUNGPOO P.O.,
via SILIGURI, BENGAL,
March 19, 1927.

G. E. SHAW.

[With reference to Mr. S. F. Hopwood's note on the Red-legged Falconet (*Microhierax eutolmus*) hawking butterflies which appeared on page 826, vol. xxxi of this Journal together with our editorial comments, our attention has been drawn by Sir Peter Clutterbuck to some notes published recently which form an interesting supplement to our knowledge on the subject.

Vol. i, Part ii of the Proceedings of the Entomological Society of London (p. 32) has the following report:

'The Pigmy Falcon capturing Butterflies in Kelantan. The President drew attention to the following observation recorded by Mr. F. F. Laidlaw, M.A., in *Journal 88 of the Malayan Branch of the Royal Asiatic Society,* October, 1923, p. 377:—"Whilst I was at Kuala Aring in Kelantan in September 1899 I was interested to notice on more than one occasion a small party, three or four individuals I think, of the Pigmy Falcon (*Microhierax fringillarius*). These birds used to sit on the higher branches of a dead tree which stood in the middle of a small clearing in the forest close to the kampong. Their occupation seemed to consist chiefly in capturing butterflies, and there was constantly a litter of wings on the ground about the foot of the tree. Amongst them were the wings of *Papilio delesserti* (Guer.), an insect I did not at the time have means of identifying. It was, however, common at Kuala Aring, in fact abundant; and though I am writing from memory more than twenty years after making the observation I am quite sure of the fact."

Mr. Laidlaw's observation supplied interesting confirmation of the notes recorded by the late Col. C. T. Bingham in *Essays on Evolution,* Poulton, 1908, pp. 289-91. Col. Bingham also found that Papilios formed a large portion of the butterflies captured by *Microhierax,* and among them were those of *Papilio caunus,* Westw., a mimic of *Euplœa.* The observations suggested, as did Dr. V. G. L. Van Someren's note in *Proc. Ent. Soc.,* 1923, p. lxi, that the birds referred to discriminated between the *Papilio* mimics and their Danaine or Euplœine models.'

Dr. Van Someren's note referred to above appears as follows: 'A Hawk attacking *Papilio rex* Oberth., at Nairobi.'—Prof. Poulton exhibited a male *rex* with the male of its Danaine model *Tirumala* (*Melinda*) *formosa,* Godm., taken on the same day, January 14, 1919, at Nairobi, by Canon St. Aubyn Rogers, and read the following note written on July 28, 1923, by Dr. V. G. L. Van Someren:—'I rescued a *P. rex* the other day from a small species of hawk—*Accipiter minullus tropicalis* Reichenow—rather strange, particularly as *M. formosa* swarmed in the patch of flowers where *rex* was taken.'

The other notes on the subject to which Sir Peter refers are to be found in Dr. G. D. Hale Carpenter's recently published book *A Naturalist in East Africa.* On page 21 the author records that in a quarter of an hour's watching he counted sixteen little 'Blues,' nine *Atella* (a brown butterfly about the size of the English 'Tortoiseshell'), three sulphur-yellow *Terias* and one *Eronia leda* which resembles the English 'Brimstone', devoured between two wagtails—*Motacilla vidua.* Dr. Carpenter continues: 'But they made no attempt to eat any of the extremely abundant "White" (*Belenois* and *Pinacopteryx*) which were there, and walked about among them without appearing to take any notice of them, nor did they pay any attention to the Danaine *Tirumala mercedonia,* a typically aposematic butterfly, of which numbers were sitting together on a stone on which one of the birds was actually perched. I never saw them pay any attention to the mimetic *P. ridleyanus.*

The total of twenty-nine butterflies eaten in half-an-hour is certainly an underestimate, for often when watching one bird I heard the bill of the other snap, and, giving it a hasty glance, saw that it was swallowing something. If one considers that these birds had been eating butterflies before I had arrived, and were still doing so when I left, it must be allowed that they had eaten probably fifty butterflies! Every now and then one of them got so full that it had to sit still and rest, all humped up, before it had room to begin again!'

After recording a number of similar observations, Dr. Carpenter concludes by remarking: 'If one considers that these birds frequented those same puddles daily, and ate "good and 'earty" for a great part of the day, one cannot understand the arguments of those who say that birds do not eat butterflies in sufficient quantity to have any influence upon them as a selective agent and therefore cannot cause mimetic resemblances.'

Dr. Hale Carpenter's notes are very interesting, and it would appear that the long-held notion that birds do not eat butterflies to any considerable extent stands in need of modification in the light of recent investigation.

However, assuming that these insects *are* preyed upon by birds in sufficiently large quantities to foster mimetic resemblances amongst them, one fails to appreciate the significance of such mimicry when it falls short of affording protective value to the mimic. EDS.]

XV.—A SHORT-CUT BY BIRDS TO THE HONEY IN THE FLOWERS OF *SESBANIA GRANDIFLORA*

[Reprinted from the *Journal of Indian Botany*, vol. v, No. 3 (December, 1926)]

Numerous examples are known to anthœcologists of 'Unbidden Guests'. These, as is well-known, steal from the flowers the store of honey meant for the use of pollinating insects. The result is that the right kind of insects no more pay their visits, with the consequence that the fertilization of flowers is either prevented, or its chances considerably decreased. The effect of this on the seed-producing capacity of the plant is considerable.

A remarkable instance of this is to be found in the flowers of *Sesbania grandiflora,* a plant belonging to the family Leguminosæ, which came to the writer's notice while collecting material for class use. This plant begins to flower in Benares about the beginning of November and continues to do so almost till the end of January. This period happens also to correspond almost exactly with the time when feathered visitors migrate in large numbers to these parts from colder regions, and on closer observation it was found that it is largely these birds which are responsible for robbing the plant of its store of useful nectar, without doing any service in return.

In order to appreciate fully the intelligent way in which these birds carry on their business, it is necessary to give a brief account of the morphology of the flower. When fully developed, the flowers, like those of almost all other Papilionatæ, bear a striking resemblance to the pose of a bird in flight. And it is this resemblance, enhanced as it is by the white colour of the flowers, that appears to be responsible for the Bengalee name 'Bok' (Duck) given to them. The standard is clawed, and in fully opened flowers bends strongly forward in the form of a cowl over what looks like the bird's head. The latter is formed by the calyx-tube surrounding the essential organs and serves for the storage of honey. In the bud-condition, the standard forms a sort of tight jacket round the other petals and jointly with the calyx effectively guards all approaches to honey.

The honey is secreted by a number of glands situated on the inner side of the united bases of 9 stamens around the ovary, and stored in a beautiful bowl-shaped cavity formed by them. The filament of the 10th free stamen fits nicely over a gutter-like groove in front to prevent any drain of the fluid, and forms together with the base of the ovary a partition dividing the honey reservoir into two lateral chambers. The claw of the standard lies vertically over this partition and is of such width that it just leaves two oval holes at the top, simulating the orbits in a human cranium and apparently serving as approaches to the honey.

The interesting point in the stealing process is the fact that the robbers seem to have found out the exact position of the honey passages, and peck holes at the spot with great deliberation and precision. Out of the many flowers examined by the writer, only rarely specimens were met with, which showed evidences of pecking wide of these points, and these probably represent attempts of foolish or inexperienced birds. Another interesting point, and one which brings the intelligence of these birds surprisingly into prominence, is the fact that only those buds which have developed sufficiently to be able to secrete honey, are sought, the younger ones are apparently deliberately avoided, except in rare instances for which again inexperienced or stupid birds may be responsible.

Cases like these are of immense interest and open up many questions with regard to the intelligence of birds. How is it, for instance that they get to know the particular stage of development at which the nectary begins to secrete honey? ; and again how is it that they come to locate exactly the positions of the honey passages in the unopened buds? Instinct and intuition may enable one to understand the habit of birds in approaching the flowers, but they scarcely suffice to explain the wonderfully exact nature of their behaviour in locating the exact points where holes ought to be made, and in selecting only those flower-buds in which nectaries have begun to function.

The following birds have been noticed in the act of pecking the flowers in addition to squirrels, which bite at and destroy flowers in large numbers. But the list is not claimed to be by any means exhaustive, and doubtless there must be other birds concerned.

Psittacula torquatus	...	The Common Parroquet.
Leptocoma asiatica	...	The Indian Purple Sunbird.
Molpastes hœmorrhous	...	The Red-vented Bulbul.

In addition to these the common Myna (*Acridotheres tristis*) and the House Crow (*Corvus splendens*) have also been seen sitting in large numbers on the plant, but the writer has not had any occasion to notice them in the actual act of pecking.

N. K. TIWARY, M.SC.,
Dept. of Botany, Benares Hindu University.

XVI.—ARTIFICIAL AND NATURAL MIMICRY

In the pages of the *Illustrated London News,* dated May 7, 1927, in his contribution on mimetic Cuckoos it is gravely asserted by Mr. W. P. Pycraft that the black Indian cuckoo known as the Koel (*Eudynamis honorata*) foists its young on a kind of crow known as the *mynah.* Now our familiar Indian grey-necked crow is not so black as Mr. Pycraft would have his readers believe nor is he a *mynah.* He is not mistaken as to the identity or nature of the male of the Indian black cuckoo whom he invariably chases away from the vicinity of his nest and as is well-known to every bird observer in India the female koel foists her eggs on a crow's nest by stratagem and not through the supposed mimetic resemblance of her mate to a crow. Nor do the nestlings of the Koel resemble the male so as to deceive their corvine foster parents. The writer has seen crows feeding young Koels in the brown, grey and speckled plumage of the female cuckoo and it is to be feared that the plumage of the male koel, black though it be, does not entitle him to be included as a corvine mimic. It seems to be a besetting weakness in the minds of some entomologists and ornithologists to lump instances of resemblances amongst birds and insects under the category of mimicry. It has been gravely asserted in scientific journals that the markings on the forewings at the great Atlas moths are protective from their resemblance to the head of a snake and also that the great eye-spots on the lower wings of a South American butterfly and a large Indian Saturnid moth are likewise protective from their resemblance to the facial disc of an owl. All such hocus-pocus are instances of artificial or spurious mimicry evolved in the minds of the framers of such hypotheses. It could equally be strongly urged that the sepulchral markings on the thorax of a death's head moth are warning indications to the superstitious entomologist to keep his hands off, and hence of a protective nature to the moth. It may be asked what then is true mimicry as distinguished from the artificial mimicry referred to? To which it may be replied that there are to be seen everywhere in a state of nature tens of thousands of living organisms whose appearance down to the minutest spot and wrinkle is a facsimile of the model that they imitate. Such mimics are veritably living lies and are to be found in the insect world. Stick insects, leaf insects, leaf butterflies and crickets, and perhaps most marvellous of all are those insects that resemble the white droppings of birds so closely that one's first impression is that a bird dropping has suddenly become alive and is moving over a rock. It cannot be; our eyes must have deceived us, but presto! the bird dropping moves again and then we feel quite sure that it is really an insect. Just a flat patch of white on a stone about the size of a three penny bit of an oval shape and of a pure unsullied white. The Indian oakleaf butterfly is likewise a marvellous mimic but only when at rest. The general outline of the closed wings is that of an oblong acuminate leaf, the elongated tail of the hind wing corresponding to the stalk of a leaf with midrib running through the centre and terminating in the apex of the forewing. Countless other instances could be given by every observer who gets his knowledge of nature not from books but by observation, but who on the other hand must not strain facts to fit in with some hypothesis evolved from the mind. It was well said by a great writer that the world is full of clues, and that if a man's mind is sharp set on any quest, he notices and takes advantage of what otherwise he would miss. This is specially applicable in the study of animal life.

BOMBAY,
May 27, 1927.

H. JOUGUET.

XVII.—A LIST OF SNAKES AND LIZARDS FROM PANCHGANI

Through the kindness of Rev. E. Blatter I received the following snakes and lizards collected by him during his stay at Panchgani. All the specimens were collected from an altitude of 4,100—4,400 feet. On going through the collection I find that it comprises eighteen species of snakes and five species of lizards. It appears that amongst snakes *Silybura brevis*, *Macropisthodon plumbicolor, Coluber helena* and *Naia naia* are fairly common at Panchgani. The collection holds a single specimen each of *Hemibungarus nigrescens* and *Echis carinata.* The commonest lizards to be found are *Calotes versicolor*, *Hemidactylus maculatus, Gymnodactylus deccanensis and Mabuia carinata* :—

Sub-order.—OPHIDIA

Family.—UROPELTIDAE

Genus.—*Silybura* Gray

Silybura macrolepis Peters. The Large-scaled Earth Snake.
Silybura brevis (Günther). Cuvier's Earth Snake.

Family.—COLUBRIDAE
Series.—AGLYPHA
Sub-family.—Colubrinæ

Genus.—*Nerodia* Baird and Girard

Nerodia (*Tropidonotus*) *piscator* (Schneider). The Chequered Keelback. 'Pániválá '.

Genus.—*Macropisthodon* Boulenger

Macropisthodon (*Tropidonotus*) *plumbicolor* (Cantor). The Green Keelback.

Genus.—*Lycodon* Boie

Lycodon aulicus (Linné). The Common Wolf Snake.
Lycodon travancoricus Boulenger. Beddome's Wolf Snake.

Genus.—*Ptyas* Fitzinger

Ptyas (*Zamenis*) *mucosus* (Linné). The Common Rat Snake or 'Dháman'.

Genus.—*Zamenis* Wagler

Zamenis fasciolatus (Shaw). The Fasciolated Rat Snake.

Genus.—*Coluber* Linné

Coluber helena (Daudin). The Trinket Snake.

Genus.—*Oligodon* Boie

Oligodon tæniolatus (Jerdon). The Variegated Kukri Snake,

Genus.—*Liopeltis*

Liopeltis (*Ablabes*) *calamaria* (Günther). Günther's Smooth Snake.

Series.—OPISTHOGLYPHA

Sub-family.—Acrochordinæ

Genus.—*Dipsadomorphus* Fitzinger

Dipsadomorphus ceylonensis Günther. Günther's Cat Snake.

Dipsadomorphus trigonatus (Schneider). The Common Cat Snake or Gamma Snake.

Genus.—*Dryophis* Dalman

Dryophis mycterizans (Linné.) The Common Green Whip Snake. 'Hirá or Hirvá Samp'.

Series.—PROTEROGLYPHA

Sub-family.—Elapinae

Genus.—*Bungarus* (Daudin)

Bungarus candidus (Linné). The Common Krait, 'Manar or Maniár'.

Sub-family.—Hydrophinae

Genus.—*Naia* Laurenti

Naia naia (*tripudians*) (Linné.) The Cobra. 'Nága'.

Genus.—*Hemibungarus* Peters

Hemibungarus nigrescens (Günther.) Günther's Coral Snake.

Family.—VIPERIDAE

Sub-family.—VIPERINAE

Genus.—*Echis* Merrem

Echis carinata (Schneider). The Saw-scaled Viper. 'Phoorsa'.

Sub-order.— LACERTILIA

Family.—GECKONIDAE

Genus.—Gymnodactylus Spix

Gymnodactylus deccanensis Günther.

Genus.—*Hemidactylus* Gray

Hemidactylus maculatus Dum. and Bibr.

Family.—AGAMIDAE

Genus.—*Calotes* Cuvier

Calotes versicolor Günther. The Common Bloodsucker. 'Sardá'.

Family.—VARANIDAE

Genus.—*Varanus* Merrem

Varanus bengalensis Boulenger. The Common Indian Monitor. 'Ghorpad'.

Family.—SCINCIDAE

Genus.—*Mabuia* Fitzinger

Mabuia carinata Boulenger. 'Sámpbámni'.

ST. XAVIER'S COLLEGE,
BOMBAY, *March 17, 1927.*

J. P. MULLAN.

XVIII.—PREYING HABITS OF THE TENT BUILDING SPIDER

I am unfortunately (or should I in view of the profundity of the articles on the subject in the Journal, say fortunately?) not what Mr. Pycraft would term an Etymologist, but I should be grateful if any reader of the Journal would enlighten me on the subject of a tragedy now taking place on the wall of this inspection bungalow over my office table—A small spider with a body about the diameter of one of my office pins is violently rushing in small circles round a small brown beetle-like insect with a body about as long as the head of a pin in width. The spider after about half a dozen revolutions clockwise, reverses its direction and puts in a spell anticlockwise. The beetle is obviously in difficulties and I conjecture that the spider is hobbling it by the winding an invisible thread round its legs.

The beetle is by now standing on its head with its body at right angles to the wall and bowing feebly; the spider is still revolving. What is the spider doing? is it merely tying up a capture in order to make a quiet dinner (it is now 7.30 p.m.) undisturbed by the dinner's struggles, or is it laying the beetle by for to-morrow's breakfast, or is the beetle to stay alive as food for the spider's progeny? I should be grateful for enlightment—as grateful as I am to the spider and the beetle for relieving an evening of undiluted office work.

CAMP MUKTI,
WEST KHANDESH,
January, 6, 1927.

H. F. KNIGHT, I.C.S.

[Commenting on the above Major R. W. G. Hingston writes as follows :—
The spiders Mr. Knight refers to belong to the family *Urocteidæ.* They construct silk tents in the angles of walls and are very common in India.

The tent consists of two layers and the spider lives between the layers. A delicate entanglement of threads is spread over the wall around the tent. The spider waits for prey within its tent. An insect happens to crawl near the tent, gets its feet caught in the surrounding entanglement. The spider then rushes out with lightning rapidity, whirls round and round the insect in one direction, all the time paying out a thread. Then it reverses and throws out another series of coils in the opposite direction. These circlings continue in alternating directions until the capture is completely enmeshed. The spider then takes the victim in its mandibles, injects a drop of poison, drags it into the tent, and sucks out its body juices.

The operation is therefore a kind of noosing or lassoing. The thread cast round the victim is very fine and can be seen only with a lens. So far as I have observed, ants are the usual prey of this spider. But small beetles will be captured if they happen to come that way.

I may add that Mr. Knight's observation is strictly exact. The habits, behaviour, etc., of this spider with a detailed account of its capturing operations have been described in a chapter entitled 'The Tent Building Spider' in my book *Nature at the Desert's Edge.* I do not know of any description of these habits published elsewhere. EDS.]

XIX.—SOME OBSERVATIONS ON THE COMMON INDIAN MILLIPEDE, *SPIROSTREPTUS* BRANDT

(*With a plate*)

The first stage in the study of Zoology in this country, when almost all the types studied were foreign, is now happily over. The types described in the Text-books, often not obtainable in this country, are being gradually replaced by animals which we find in our own neighbourhood; and with the help of pioneers like Dr. Prashad[1] and Dr. Bahl[2] we might expect a time not far remote when the Indian students' syllabus will be as free from all imported material as is necessary and desirable.

Study of life-history at first-hand, cannot fail to lend an additional interest to the anatomical details which so often prove dry and difficult to the beginners without it.

The Millipede that we are working on, with this object in view belongs to the phylum, Arthropoda, class Myriapoda, and sub class Progoneata.[3] It is fairly common in this part of the country, and is of a big enough size to be studied conveniently (about 4-6 inches long and 2 cm. broad). Its habits are interesting, and it can be kept in confinement under prolonged observation during which it may be induced to breed.

A large number of them were captured at the end of July and put in big glass jars containing a quantity of coarse saw-dust sprinkled with water. This

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[1] B. Prashad, Anatomy of the Common Indian Apple-snail (*Pila globosa*) *Memoirs of the Indian Museum,* Calcutta, vol. viii, No. 3, 1925.

[2] Bahl, K. N., *Pheretima posthuma, The Indian Zoological Memoir on Indian Animal Types,* Lucknow, 1926.

[3] Progoneata = Myriapoda in which the genital apertures are situated far forwards towards the anterior end of the body.

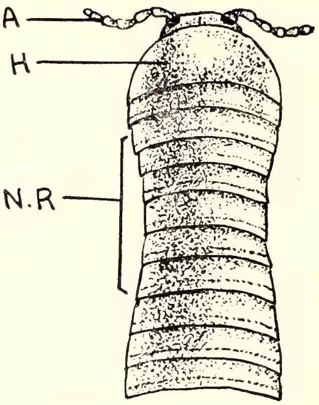

Fig. 1.—Anterior region of Female.

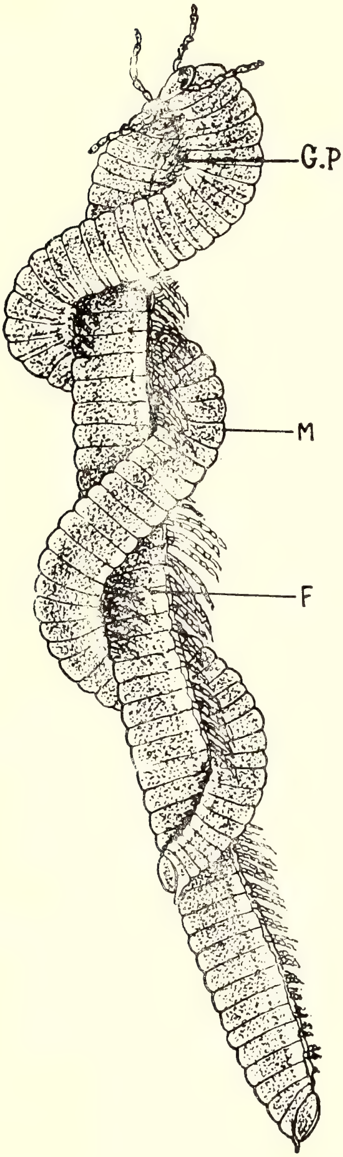

Fig. 3.—*Spirostreptus* in copulation.

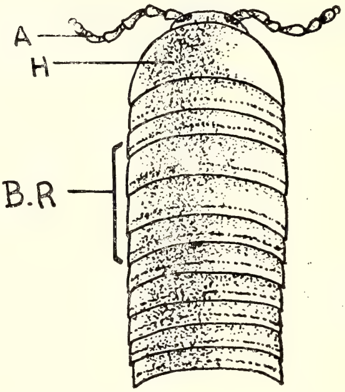

Fig. 2.—Anterior region of Male.

The Common Indian Millipede (*Spirostreptus*, Brandt.)

material is more suitable than ordinary soil because the animal can easily bore tunnels in it, and the moisture of this subtratum can be better regulated and varied according to need than is possible with garden soil, though no doubt, that is what the animal uses in nature. Further if a sufficient thickness of this material is used we get different layers from the bottom towards the top which vary in their water contens, and the animal has an option of selecting the right zone as to moisture and temperature—a point which is of vital interest to the captive animals during the winter season when their mortality is pretty high due to cold.

These millipedes are quite active, voracious feeders during the months of August, September, and October; but their activity and appetite suffer a remarkable diminution during November and December, when the atmospheric temperature is quite low.

They are purely vegetable feeders avoiding carrion when supplied as a test. They were tempted to eat of a piece of cake when hard pressed, but developed a kind of diarrhœa on the third day looking weak and depressed in spirit. They were again put on their usual vegetable diet and regained health quickly. Of the vegetables they seem to be partial to potatoes, both raw and boiled, pith of cabbage and *Trapa* (Singhara).

They avoid strong light, hiding themselves in their burrows, and come up to the surface for feeding late in the evening; they are quite busy eating and crawling at dusk.

The male and the female can be distinguished at a glance by looking at their anterior dorsal end. The head of the female is globular and the outline gracefully narrows behind the head for a short length before it assumes its former breadth (Fig. 1); whereas in the male there is no such narrowing at all—in its place we find two rings which are extra broad (Fig. 2). This is the best character to find the sex of the animal without handling it.

We found the animals in conjugating position very often in the months of September and October, and very young ones were also obtained from the fields at the same time.

Heathcote of Trinity College, Cambridge, collected a number of *Julus* in 1882 and observed them. He says that he is unable to find how long a time elapses after copulation before eggs are laid, but that he thinks it is short. Our observations are different according to which a pretty long time must elapse before eggs are laid. On referring to the literature that we have been able to consult we find no reference to the method of copulation, except Heathcote (1882) who says 'I have observed copulation which exactly takes place as described by Cuvier in his *Regne Animal* but on referring to the English translation of the book which we possess we could find no mention of it.

The copulatory posture might easily be mistaken for a life and death struggle between two opponents, so violent does it appear. The male suddenly bites the upper lip of the female between its own upper and lower lips; thus catching hold of the female it tightly coils round its body (Fig. 3). The genital apertures which are situated on the ventral side, a few segments behind the mouth, being apposed against each other.

In the writhing movements that follow the anterior third of the animals stand erect above the ground, the accessory copulatory organ of the male being firmly thrust into the female aperture. It lasts for about three to four minutes, and it is the male who takes the aggressive part.

Fabre (Ann. Sci. Nat. 1855) has described the breeding season to be September for captive animals. Sinclare has observed it to be May. We hope to be able to get eggs early next summer. If we are successful then it would appear that copulation takes place all the year round excepting the cold winter months. C. McCann of Xavier's College, Bombay, observed a nest of *Polydesmus* containing a single egg in the month of September; but as the egg contained an advanced embryo it must have been laid considerably earlier.

There is thus, it appears, no agreement between the habits of the few millipedes observed up to this time and it is therefore all the more necessary that the habits of this particular millipede should be known accurately.

The literature about the early development of millipedes is not too complete to be added to, and if they can successfully be made to lay eggs under observation, as we venture to hope, they would, under the conditions we have arranged—enough of fresh material would be in hand to push on with the subject.

Our best thanks are due to Dr. B. Prashad of the Indian Museum, Calcutta, for kindly identifying the Millipedes to be a *Spirostreptus*, and to Dr. K. N. Bahl, Professor of Zoology, Lucknow University, who suggested the work in hand.

M. L. BHATIA, M.SC.,
Lecturer in Zoology, Lucknow University.
and S. S. CHAUDHURY, M.A., M.SC.

LUCKNOW,
March 1927.

XX.—A PLAGUE OF GREEN BUGS (*NEZARA VIRIDULA*)

In July 1925 an extraordinary plague of the brown species of *Nezara viridula* (commonly known as the 'Green bug,' emitting a most disagreeable smell when touched) occurred in a shola above and bordering on my estate. Seething masses of the bug flew and crawled through the shola, covering the ground and the trees completely. They seemed to be feeding on nothing and were dying in millions and they were attacked I noticed by neither bird nor mammal! The smell was overpowering and disgusting. They moved out of the shola down into the estate and congregated on the branches of the shade trees, smashing all the branches of the Grevilleas by the sheer weight of their numbers. It had to be seen to be believed. When the survivors (still in their myriads) finally moved out of the estate they had left a lane a hundred yards wide, of shade trees with every branch and limb broken down and hanging.

HONNAMETTI ESTATE,
ATTIKAN P.O. *via* MYSORE,
April 5, 1927.

RANDOLPH C. MORRIS.

XXI.—THE USE OF PATENT BULLETS IN SHOT GUNS

In the Miscellaneous Notes of vol. xxxi, No. 4 of the Society's Journal, I read with interest the note on various patent bullets for use in smooth bore guns.

My own personal experience of them—and I have used them for a good many years—lies half way between the views of Mr. McCulloch and Col. Burton. Above fifty yards I do not think any of the patent bullets can be relied on for accurate shooting, but as regards their penetration I have a very high opinion indeed of them. My own experience only extends to the use of Lethal Ball and Rotax Bullets.

To give concrete examples I will just mention a few cases:—

A Sambhar at 40 yards. Lethal ball.—Bullet passed clean through the sambhar just behind shoulder.

A pig at 30 yards. Lethal ball.—Bullet passed obliquely through animal from near hind quarter to off foreleg. The pig was a large sized boar.

Two panthers at 20 yards. Rotax bullet.—In each case the bullet struck near the shoulder and passed far into the interior of the animal. One was a side shot and the other a frontal shot. In both cases the bullet smashed into little pieces inside, doing tremendous damage.

As a general rule the bullets penetrate but do not pass through, usually breaking up inside, but the above instances show what they are capable of. As regards the statement in Messrs. Rodda's catalogue, I have no doubt the statement is a copy of a letter received by them, but I am very sceptical as to the truth of the statement for the following reasons:—

It is fairly evident the tigers were shot from elephants in a drive. Now, it is very improbable that anybody would go for such a shoot armed with a smooth bore gun, as elephants usually imply considerable means or influence, and anybody in possession of either would also probably be in possession of a double H.V. rifle, which he would naturally use in preference to a smooth bore.

If we allow for the improbable, one might make a lucky shot at 110 or 135 yards or even 165 yards, because the penetration of these bullets is wonderful, but to make three such shots consecutively, and the last of them a galloping shot, is more than I can believe on the evidence available.

MAKRI, KONDAGAON P.O.,
BASTAR STATE, C.P.,
May 6, 1927.

W. H. O. SHORTT.

MEMORANDUM OF ASSOCIATION

NAME

The name of the Society is the BOMBAY NATURAL HISTORY SOCIETY.

OBJECTS

(*a*) To promote amongst the public the knowledge of Natural History in all its branches, including particularly the study of Animal and Plant Life of the Oriental Regions and the Zoo-Geographical Regions adjoining thereunto both alive and otherwise.

(*b*) To carry out researches in all branches of Natural History and to assist with information and advice as well as financially where possible, other institutions and individuals in similar pursuits.

(*c*) To provide, purchase, construct, equip, maintain and replenish a museum or museums or other repositories for animals or plants living or dead which are suitable for the study of Natural History.

(*d*) To carry on the business of Taxidermists and Preservers.

(*e*) To nominate and appoint members and to receive and recover contributions from them in aid of the objects of the Society.

(*f*) To engage and remunerate experts and other staff for any or all of the objects of the Society and to do and make all other acts, matters and things ancillary thereto or necessary and convenient for the purposes of the Society including the purchase or taking on lease of land and buildings.

(*g*) To do all or any of the aforesaid objects either solely or jointly with another or others and to enter into agreements for joint management, joint working, collaboration and any other arrangements with societies or persons having similar or allied objects which may further or benefit the objects of this Society.

We, the undersigned, hereby request that we may be formed into a society under the Societies Registration Act of 1860.

Note.—The signatories will be members of the Committee residing in Bombay. The names of the present Committee are entered here for information of members and these will form the first Committee of the Registered Society.

1927

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RULES AND REGULATIONS

THE MEMBERS

1. The Bombay Natural History Society (hereinafter referred to as 'the Society') shall consist of an unlimited number of members of either sex whose election shall be vested in a Committee constituted as provided in Rule 32 (hereinafter referred to as 'the Committee'). Persons who were members of the Society prior to its registration shall be deemed to remain members of the Society unless they shall otherwise determine and any life or other subscription paid by them shall for the purpose of regulating their position or status in the Society be deemed to have been paid to the Society.

There shall be three classes of members—Life Members, Ordinary Members and Honorary Members.

2. Every candidate for admission as a member other than an Honorary Member shall be proposed and recommended in writing by one or more members of the Society.

3. The Entrance Fee both for Life Members and Ordinary Members shall be Rs. 20, but the Committee may from time to time vary the same. No person shall be deemed to be a member until the entrance fee and subscription either as Life Member or Ordinary Member has been paid.

4. No dividend, gift, division or bonus shall be made by the Society unto or between any of its members in his or their capacity as member only, but any member occuping the position of a salaried official shall be entitled to receive remuneration from the Society for his services.

LIFE MEMBERS

5. *Life Members* are those members who have either on election or at some later date contributed to the funds of the Society in one sum a contribution of Rs. 350 or such other sum as may be fixed by the Committee from time to time.

6. Scientific Societies, Institutions, Libraries, Clubs, Officers' Messes and other such Co-operative bodies shall be admissible as members in their co-operative capacity, but shall not be admissible to life membership; such bodies may compound their annual subscription for a period of twenty-two years by payment to the funds of the Society of a sum of Rs. 350 or such other sum as may be fixed under clause 5 hereof.

7. The capital obtained from Life Membership contributions and compounded subscriptions shall not be used as revenue.

ORDINARY MEMBERS

8. *Ordinary Members* are those persons who on election pay the entrance fee mentioned in Rule 3 hereof and the annual subscription.

9. If any person elected as a member shall omit to pay the entrance fee and annual subscription within six months from the date of his election, the Committee shall be at liberty to declare such election void.

10. The first annual subscription of members elected during the months of October, November and December in any year shall be considered to extend to December 31 of the following year. Any ordinary member subsequently becoming a life member may deduct from the amount of Rs. 350 the amount of the annual subscription paid by him for the then current year.

11. The admission fee and annual subscription of members resident outside India, or of members absent from India shall be the same as for members resident in India.

12. The payment of the entrance fee by a member shall be considered as an acceptance by such member of all the rules, regulations and bye-laws of the Society including the power to alter or vary the same.

13. The annual subscription of Rs. 25, or such other sum as may from time to time be fixed by the Committee, shall become due on the 1st of January in every year in advance. No member whose subscription is in arrear may exercise his privileges of membership; provided nevertheless that the Committee shall have authority to restore such defaulters on payment of all arrears.

14. When any member shall be in arrear in the payment of his annual subscription for two years he shall be advised by letter, addressed to his last known place of residence, that unless the amount due by him be paid within two months his name shall be removed from the list of members, and in the event of his failing to pay the amount within the period stipulated his name shall be removed from the roll of members. The Committee may however restore the name of any person so removed upon such terms as they may think fit.

15. Every member shall furnish in writing to the Honorary Secretary his address and any changes therein. The Society shall accept no responsibility for any loss or inconvenience that may arise through failure on the part of the member to carry out the provisions of this clause; nor shall it be necessary for the Honorary Secretary to issue any notice to members failing to do so.

HONORARY MEMBERS

16. *Honorary Members* shall be eminent Zoologists or Botanists residing abroad who have rendered distinguished service to the Society and shall not exceed ten in number. Candidates for honorary membership shall be proposed by the Committee only and shall be elected by a majority of not less than three-fourths of the members of the Committee present and any person so appointed shall be denominated an Honorary Life Member and shall have all the privileges of a life member under the rules in that behalf.

WITHDRAWAL AND REMOVAL OF MEMBERS

17. Every member, having paid all fees due by him to the Society, shall be at liberty to resign therefrom upon giving notice in writing to the Honorary Secretary.

18. If any member shall have acted in a manner injurious to the good name of the Society or his membership shall have become undesirable so that it shall become expedient to remove his name from the list of members, the same shall be effected by a resolution of the Committee to be confirmed by a general meeting of the Society. The proposition shall be ballotted for and if eleven or more members vote and not less than two-thirds of the members so voting shall vote for such member's removal, he shall be removed from the Society accordingly.

PRIVILEGES OF MEMBERS

19. Members have a right to be present and vote at all general meetings of the Society, to propose candidates for election to the Society and to have personal access for themselves or, at their request, their friends to such collections of the Society as are not open to the general public, to attend meetings of the members or functions of the Society and to introduce, either in person or by signed orders, visitors to any such meetings of the members or functions of the Society. Provided always that no friend or other person not being a member of the Society shall be entitled to be present at any general meeting of the Society convened for the transaction of the business of the Society.

20. Any member by making application (in writing if required) to the Honorary Secretary may have liberty of access to the Society's Library. Members may borrow for a stated period from the Society's Library such books as are not required for constant reference, with the proviso that a member shall be liable to replace any loss or make good any damage to books while in his keeping.

21. One copy of the Society's Journal shall be sent free to every honorary member and life member and also to every ordinary member whose subscription is not in arrears.

22. The services of the Society's Taxidermist Department for the treatment or setting up of Big Game Trophies, etc., are specially at the disposition of members subject to the exigencies of work required for the Museum. Members will be charged lower rates than will be chargeable to non-members.

23. Members shall have the right to purchase all publications of the Society at such price below the published price as may from time to time be fixed by the Committee.

THE ANNUAL GENERAL MEETING AND THE ELECTION OF THE COMMITTEE, AND OF THE GENERAL MANAGEMENT OF THE AFFAIRS OF THE SOCIETY

24. A general meeting of members of the Society shall be held annually in the month of March or as soon after as may be convenient, on a day to be fixed by the Committee. The annual general

meeting shall be competent to receive and adopt the annual report and audited statement of accounts of the Society for the past year and to transact any other business which may be brought forward by the Chairman.

25. Notice of the time and place of the Annual General Meeting shall be advertised in two of the local newspapers and printed in two newspapers published outside Bombay at least fourteen days before the same shall take place.

26. The course of procedure at the Annual General Meeting after the chair has been taken, shall be as follows :—

(*a*) The reading of the annual report of the Committee.
(*b*) Presentation of the balance sheet and statement of accounts for the past year.
(*c*) The election of the Committee.
(*d*) Such other business as may be properly brought before the meeting.

27. No business shall be transacted at any general meeting of the Society unless a quorum be present when the meeting proceeds to business; six members personally present shall constitute a quorum. If within fifteen minutes from the time appointed for holding a meeting a quorum be not present, the meeting shall be adjourned to the same day in the following week, at the same time and place, and if at such adjourned meeting a quorum be not present within fifteen minutes from the time appointed for holding the meeting, the members present, whatever is the number, shall be competent to transact the business for which the meeting was convened.

28. Any question which may arise at any general meeting of the Society or at any meeting of the Committee shall be determined by vote, each member having one vote and the President or Chairman a casting vote in addition to his own vote.

29. The Committee may, whenever they think fit, convene an Extraordinary General Meeting and they shall on the requisition of at least ten of the members forthwith proceed to convene an Extraordinary General Meeting of the Society.

30. Any request so made by members shall express the objects of the meeting proposed to be called and shall be left at the office of the Society. Provided that such requisition may consist of several documents in like form each signed by one or more requisitionists. Upon the receipt of any such requisition the Committee shall forthwith convene an Extraordinary General Meeting and if they neglect to do so within one month from the date of delivery of such requisition at the office of the Society the requisitionists may themselves convene an Extraordinary General Meeting for the purpose specified and not for any other purpose, but no meeting so convened shall be held for three months from the date of the delivery of the requisition as aforesaid.

MANAGEMENT OF THE SOCIETY

31. The government and management of the Society shall be vested in a Committee consisting of the President, Vice-Presidents, Honorary Treasurer and Honorary Secretary, ex-officio and ten members resident in Bombay or within 200 miles of Bombay

exclusive of ex-officio members. This Committee shall be assisted in an advisory capacity by ten members chosen by the Committee from amongst members resident in the mofussil more than 200 miles from Bombay. All papers in connection with meetings of the Committee shall as far as possible be sent in advance to the Advisory Members of the Committee.

32. The Committee for the time being shall annually cause to be prepared a list of members whom they recommend to be elected as members of the Committee in the ensuing year. The names of the gentlemen so nominated shall be sent to all members along with the notice of the meeting and it shall be open to members, having obtained the previous consent of the nominee, to propose and second in writing within seven days of the date of the meeting the names of any members they desire to have elected. In the event of the number of members proposed for the Committee exceeding ten an election shall take place. The election shall be conducted as follows :—A list of the names proposed shall be sent to every Life Member and Ordinary Member resident in India who has paid his subscription for the year and the member shall place his initial against the names of those he wishes elected and return the same duly signed by him in a special envelope marked ' Voting Paper ' to the Honorary Secretary within three weeks of the issue of the same.

33. No voting papers shall be opened until three weeks after the date of the issue and they shall be opened by the Honorary Secretary in the presence of two members of the Committee and the result notified in writing to those elected and published in the next issue of the Society's Journal for the information of all members.

34. In the event of any vacancy on the Committee occurring during the course of the year the remaining members of the Committee may fill up such vacancy whether it be of an ex-officio member or ordinary member. Any member of the Committee absent from India for more than six months shall be deemed to have vacated his office.

35. The first Committee of the Society formed under the Societies Registration Act 21 of 1860 shall be the officers and Committee of the unregistered Society in office at the time of the registration of the Society whose names are set out in the list annexed to the Memorandum of Association.

THE DUTIES OF THE COMMITTEE

36. The Committee shall meet at such times as shall be appointed by the President, or in his absence, by one of the Vice-Presidents, Honorary Secretary or Honorary Treasurer, due and sufficient notice being previously sent to every member.

37. At any meeting of the Committee four members shall form a quorum.

38. Seven days previous notice of any meeting of the Committee shall, as a rule, be given in writing by the Honorary Secretary to each member of the Committee and such notice shall specify the nature of the business to be transacted. Business of an urgent nature may be conducted by circular ; and in such case, it shall be

necessary in order to render valid any act of the Committee done upon a resolution by circular, that the circular shall have been seen by each member of the Committee present in Bombay, and that the majority of members shall have voted in favour of the resolution.

39. Should there be at any time no legally constituted Committee of the Society, or should the Committee at any time be unwilling to fill up vacancies occurring in the Committee during their tenure of office, the Honorary Secretary shall issue voting lists, either delivered by hand or sent through the post to each member of the Society in the same manner as prescribed under Rule 33.

40. The majority of votes shall decide every question brought before the Committee and in case of an equality of votes the Chairman of the meeting shall have a casting vote in addition to his own.

41. The President, Vice-Presidents or the Honorary Secretary upon the direction of the majority present at any meeting of the Committee at which not less than six members of the Committee are present, shall be competent to sign on behalf of the Society any contracts, deeds, pleadings, and any other documents relating to the affairs of the Society and not inconsistent in their terms with the purposes or objects of the Society, or with the rules and regulations.

42. A majority of the Committee present at any meeting at which not less than six members of the Committee are present may, at their discretion, and whenever they think fit, grant to an employee of the Society (whether employment be continued or not) in consideration of past services, or to the widow or any relation of a deceased employee, either a pension or a bonus, gratuity or compassionate allowance of such amount as the Committee may fix, and upon such terms as they may prescribe, to be paid out of the funds of the Society, and the Committee may also contribute out of the funds of the Society to a staff provident fund.

43. The Committee may appoint sub-committees for any purpose connected with the management of the affairs of the Society.

44. The Committee may from time to time frame Bye-laws for regulating the conduct and management of their business, or of the meetings or functions of any sub-committee appointed by them. But no such bye-laws shall be inconsistent with any of the purposes or objects of the Society or with its rules and regulations.

45. The Committee shall be competent to invite any salaried official of the Society to be present at their deliberations.

PATRONS

46. One or more person or persons may be invited to accept the office of Patron of the Society at the discretion of the Committee.

47. Persons who have accepted the office of Patron of the Society prior to its registration shall be deemed to remain Patrons of the Society unless they shall otherwise determine.

VICE-PATRONS

48. Any member of the Society who shall subscribe in his personal capacity a sum of not less than Rs. 5,000, to the funds of

the Society to be devoted to fostering any of the objects and purposes of the Society shall with the approval of the Committee be appointed a Vice-Patron of the Society.

49. A Vice-Patron shall hold office until death or resignation.

50. Persons who were Vice-Patrons of the Society prior to its registration shall be deemed to remain Vice-Patrons unless they shall otherwise determine.

BENEFACTORS

51. Any member of the Society who shall in his personal capacity subscribe a sum of not less than Rs. 1,000 to the funds of the Society to be devoted to fostering any of the objects or purposes of the Society shall be termed a 'Benefactor' and shall become a life member if not already so.

THE PRESIDENT AND VICE-PRESIDENTS

52. The President shall preside at meetings of the Society or of the Committee and regulate all proceedings thereat and generally execute or see to the execution of the Rules and Regulations, Bye-laws and orders of the Society.

53. In the absence of the President from any meeting of the Society or of the Committee his place shall be filled by one of the Vice-Presidents, or by a member of the Committee then present, who shall for the time being have all the authority, privilege and powers of the President. If no member of the Committee be present at any ordinary general meeting, the members present shall nominate and appoint to be Chairman such member as they shall deem fit.

THE HONORARY TREASURER AND THE ACCOUNTS

54. The Honorary Treasurer or his deputy shall demand and receive for the use of the Society all monies due or payable to the Society and shall keep full and particular accounts of all sums so received. He shall also from time to time invest the funds of the Society as may be determined by the Committee. An account in the name of the Society shall be opened and all monies shall be deposited at the National Bank of India, Ltd., or such other Bankers as may be appointed by the Committee. No payment shall be made by the Honorary Treasurer without the signature of the Honorary Secretary. The Honorary Secretary may pass for payment by the Honorary Treasurer all the bills in connection with the Journal, salaries and petty expenses of the Society, without reference to the Committee, up to Rs. 1,000.

55. An account shall be opened in the books of the Society for every member of the Society stating the several sums payable by him, and time of payment of the same. The particulars also of all sums of money received and disbursed in the several departments of the Society shall be entered and the books and vouchers shall be open to the inspection of every member.

56. The financial year of the Society shall end on December 31, of each year and all accounts shall be made up to that

date and shall be audited by one or more auditors appointed by the Committee.

57. The auditor shall have the power of calling for a statement of liabilities and assets of the Society and for any information relative thereto.

58. The Honorary Treasurer shall make a report to the Society upon the day of the annual general meeting and present a balance sheet and statement of accounts for the past year which shall be printed in the Journal of the Society.

The Honorary Secretary

59. The Honorary Secretary shall conduct the correspondence of the Society.

60. The Honorary Secretary shall have supervision over all employees of the Society and shall generally see that the Rules and Regulations, Bye-laws and orders of the Committee are executed.

The Curator, Assistant Curators, Assistants, Clerks and Servants of the Society

61. The Curator, Assistant Curators, Assistants, Clerks and other servants of the Society with their respective salaries and duties shall be subject to the orders of the Committee and they shall not under any pretence whatsoever receive any perquisite or profit from their connection with the Society, except that which shall be expressly allowed by the Committee.

62. Every servant of the Society receiving or paying money on behalf of the Society shall be required before he enters upon the duties of his office to give security for the due execution thereof in such penalty and with such surety or sureties, as the Committee may deem expedient.

PROCEEDINGS

Proceedings of the Meeting held on June 28, 1927.

A meeting of the members of the Bombay Natural History Society and their friends took place on Tuesday, June 28, at 6.30 p m., at the Prince of Wales' Museum, Mr. H. A. W. Brent presiding.

The following forty-seven new members were elected since the last meeting :— Mr. D. F. Mursell, Moulmein, Burma ; Lt.-Col. F. P. Mackie, I.M.S., Bombay ; The Registrar, University of Madras, Madras ; Mr. M. Sharif, M.SC., F.R.M.S., Calcutta ; Dr. Sunder Lal Hora, D.SC., Calcutta ; Dr. H. Srinivasa Rao, M.A., D.SC., Calcutta ; Dr. B. N. Chopra, D.SC., Calcutta ; Mr. J. W. Borradaile, England ; Mr. C. T. Shaw-Mackenzie Lahore Cantonment ; Rao Bahadur Pundit Sir Sukhdeoprasad, B.A., Kt., C.I.E., Thakur of Jasnagar, Rajputana ; H. H. The Maharaja Shri Natwarsinghji Bhavasinghji, Maharaja Rana Sahib of Porbander, Kathiawar ; Lt.-Col. D. K. McLeod, Mardan ; Lt. Maharaja Purna Chandra Bhanji Deo, Ruling Chief of the Feudatory State of Mayurbhanj ; Mr. A. Todd, Bombay ; Mr. P. R. Duncan, I.F.E.S., Lucknow ; Maharaja Ramanuj Saran Singh Deo, C.B.E., Ruling Chief of Surguja State, Bilaspur ; Mrs. R. B. Robinson, Trichinopoly ; Sri Sri Sri Krishna Chandra Gajapathi Narayana Deo, Raja of Parlakimedi, Parlakimedi ; Major P. A. Opie, R.A.M.C., Poona ; Mr. R. G. Grieve, M.A., I.E.S., Ootacamund ; Mr. C. Ruxton Sharp, Bombay ; Le Directeur, Musee Royal d'Histoire Naturelle de Belgique, Bruxelles, Belgium ; Mr. J. B. Barclay, Bombay ; The University Professor of Zoology, University of Bengal, Calcutta ; Mr. J. R. Stockley Roper, R.A., Bombay ; Commander J. G. Bower, R.N., D.S.O., H.M.S. *Crocus*, Persian Gulf ; Mr. U. M. Mirchandani, Karwar ; The Director of Agriculture, Punjab, Lahore ; Mr. J. Ramsay Scott, Cawnpore ; The Mess President, 2nd Bombay Pioneers, Agra ; Mr. D. R. D. Wadia, Bar-at-Law, Bombay ; Miss P. M. Kanga, M.SC., Bombay ; Raja Kishore Chandra Birabar Harichandan, Ruling Chief of the Feudatory State of Talcher, B. and O. ; Mr. C. Frank Riches, Eastern Duars ; Col. H. H. Nawab Sir Syed Mahommad Hamid Ali Khan Bahadur, Mutaid Jung, G.C.S.I., G.C.I.E., G.C.V.O., Nawab of Rampur State, Rampur ; The President, Mess Committee, The Rifle Brigade, Landikotal, N.W.F.P. ; The Librarian, University of Dacca, Ramna, Dacca ; Mr. Lalji Naranji, Bombay ; Major J. M. McKenzie, O.B.E., M.C., Bombay ; Capt. F. H. N. Davidson, D.S.O., M.C., R.A., Secunderabad ; Mr. R. G. Kilburne, Nepal ; Mr. Gerald A. Moore, Bombay ; Maharaja Jagadish Nath Ray of Dinajpur ; Mr. H. M. Mehta, Bombay ; Dr. Norman L. Corkill, M.B., C.H.B., Nisiriyah ; Mr. B. E. Maricar, Tavoy ; and Mrs. A. H. C. Captain, Bombay.

NEW GROUPS IN THE MUSEUM

Sir Reginald Spence drew the attention of members to the new group cases which have recently been completed in the Museum. In the course of his lectures to the members of the Society and to other bodies on his return from his deputation to the United States and Europe, Mr. S. H. Prater, the Curator, had shown what great advances had been made in recent years by Museums in America and Europe in methods of Museum exhibition. Since his return, Mr. Prater and his staff have been occupied in preparing a number of new groups for the Natural History Section of the Prince of Wales' Museum, and visitors to the Museum will now be able to judge for themselves what great strides have been made in Museum technique and how science and art can be combined in the production of popular, educative and at the same time highly artistic exhibits. The Prince of Wales' Museum might congratulate itself on being the first institution of its kind to introduce these modern group cases into this country.

A DESERT SCENE

The first of these groups represents animal and plant life in the Indian desert region. Three years ago a case illustrating the same subject was placed on exhibition in the Mammal Gallery. The group had been constructed on methods that had been in vogue in museums for several years ; but a completely new technique has been employed in the construction of the new case. The scene is laid in the country near the Sind-Baluchistan Frontier. Through a window in the case the visitor looks upon a vast desert panorama of sand dunes and cactus and thorny scrub stretching to the distant horizon, where the limestone ridges of the Khirthar Range stand silhouetted against the glow of the setting sun. The vivid beauty of the desert sunset is effectively produced by concealed and filtered lights, which transfuse the sky with an orange light and cast a golden glow upon the sands. Faithful representations in wax of cactus and of the 'Ak' or Milk plant (*Calotropis*) lend reality to the scene. The animals introduced into the case are those typical of the Indian desert region and the naturalness of the setting graphically illustrates the harmony which exists between their colouration and their natural surroundings, thereby affording them an effective means of protection and concealment. An underground section on one side of the case introduces the visitor to the family life of the Desert Gerbilles which are seen in their burrow below a sand dune. Transparencies in glass set into the case depict various features of the desert landscape and illustrate the effect of scorching winds and shifting sands on the soil and its vegetation. The perspective has been cleverly maintained and an effect of limitless continuity has been given to the scene by the curved background of the group, which is one of the chief features of its construction. The painting of the background and the reproduction of the plant forms in wax are the work of Mr. K. B. Savardekar, whose painstaking and skilful work has contributed largely to the success of the reproduction.

HABITS OF SNAKES

Three new groups illustrating the life-history and habits of snakes have been added to the Reptile Gallery. The ***viviparous*** snakes, or those which bring forth their young alive, are represented by the Russells Viper with its new-born brood of thirty-four young. The realism with which the mother with her lively brood of young are portrayed must be seen to be appreciated. The ***oviparous*** snakes are exemplified by the cobra, which is seen occupying a deserted ant-hill. The snake is seen coiled round its mass of eggs while an inset shows the development of the snake from the earliest stage to the time when it is ready to free itself from the egg chamber with the aid of its egg tooth. The third case illustrates how snakes poison their prey. The *Echis* or *Phoorsa*, perhaps the most vicious of our poisonous snakes, is shown in the process of swallowing its prey. A dissection showing the poison apparatus of the snake, enlarged models showing the types of fangs and a unique photograph showing a drop of poison emerging from the tip of a viper's fang completes the lesson which the case tends to teach. The plants, grasses and other accessories to these groups have been beautifully reproduced in wax and lend greatly to their attractiveness and interest.

HOUSE FLIES AND DISEASE

An acquisition to the Insect Gallery is the new case illustrating the house fly in its relation to the spread of disease—a timely exhibit during the monsoon season in Bombay. A very beautiful and accurate model of the House Fly was presented to the Society by Mr F. V. Evans, one of its Vice-Patrons. The model shows the house fly enlarged twenty-eight times and reveals to the naked eye details of its structure which could otherwise only have been seen through a powerful lens. Enlarged models of egg, the larval and pupal stages of a fly have been introduced into the case, while a fly-ridden tray of sweetmeats shows, better than words can, one of the means by which the germs of disease are carried by flies to man.

THE MUSEUM AND SCHOOLS

The educational activities of the Museum have not been concentrated entirely on its exhibition galleries, but considerable progress has been made during the past year in the teaching of Nature Studies to children in the schools. Nineteen local schools are now co-operating in the scheme. Two lectures have been given daily in the Museum to pupils by Mr. Salim Ali, the Guide Lecturer, who has enthusiastically taken up this phase of the Museum's work. The lectures are illustrated with Museum specimens and by lantern slides. Considerable enthusiasm is being displayed by most of the classes, who as a rule show great eagerness to attend, one class coming all the way from Thana! Up to April 21, ninety-nine classes were held at the Museum attended by 3,115 pupils, and it is hoped by the end of this year that this number will be doubled unless the Education Department of Government are unable to find the funds to carry on the work started by the generosity of the late Sir Sassoon David, Kt., K.C.S.I., Bart.

HELP FOR THE BLIND

An interesting phase of its schemes for interesting the public is the work the Natural History Section of the Museum has undertaken for the blind. By previous appointment with the Principal, forty boys from the Victoria Jubilee School for the Blind were brought to the Museum. They were given a talk on animal life and were given specimens to illustrate the lesson which they could themselves handle and feel. One little fellow after examining a tiger's skull and being told about the significance and utility of its teeth at once found out after passing his hand over a cat's skull that it was a flesh-eating animal and said probably this was a cat. The Museum is very keen on developing this work for the blind and the Curator hopes before long to prepare a series of exhibits which the blind will be able to handle and feel and which will be used for illustrating lectures for them.

WILD ELEPHANTS

Sir Reginald Spence later on read a very interesting paper on Wild Elephants in the United Provinces by Mr. F. W. Champion, I. F. S. The paper has since been published in full in the Society's Journal.

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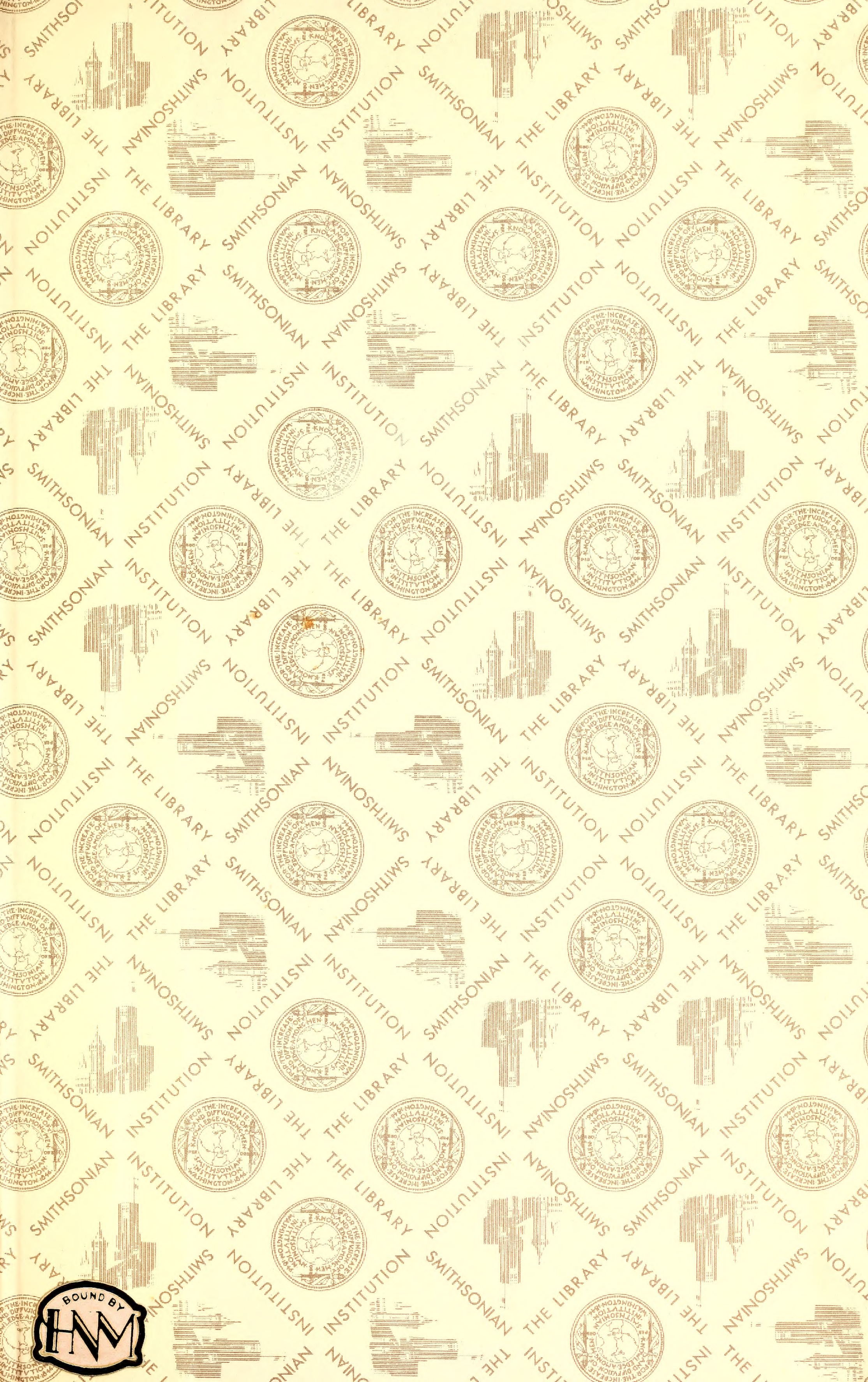

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